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# **Stratospheric Aerosol and Gas Experiment (SAGE III)**

## **Data Products User's Guide**

**Version 1.1  
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## Acronyms and Abbreviations

ATBD	Algorithm Theoretical Basis Document
CCD	charge-coupled device
Ch	channel
Char	Character
DAO	Data Assimilation Office
EFOV	effective field of view
EOS	Earth Observing System
ESE	Earth Science Enterprise
ETOS	Elapsed Time on Station
FOV	field of view
HDF	Hierarchical Data Format
IFOV	instantaneous field of view
InGaAs	Indium Gallium Arsenide
Int	integer
IR	infrared
ISS	International Space Station
LASDC	Langley Atmospheric Sciences Data Center
LOS	line of sight
NCEP	National Center for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
QA	quality assurance
RASA	Russian Aviation and Space Agency
SAGE	Stratospheric Aerosol and Gas Experiment
SAM	Stratospheric Aerosol Measurement
SP	Slant Path
STD	standard
T/P	temperature/pressure
VBP	vertex blue pixels
VRP	vertex red pixels

## Introduction

The Stratospheric Aerosol and Gas Experiment (SAGE) III is an improved extension of the successful Stratospheric Aerosol Measurement (SAM) II, SAGE I, and SAGE II satellite experiments and is designed to acquire measurements of aerosols and gases in the stratosphere and upper troposphere.<sup>[1]</sup> These measurements are needed to enhance our understanding of natural and human-derived atmospheric processes. The experiment is a component of NASA's Earth Observing System (EOS) and is mounted on the Russian Meteor-3M spacecraft. The mission is managed by NASA's Langley Research Center.

Advances in the SAGE III instrument design permit measurement of additional wavelengths during both lunar and solar occultation events. The added measurement capabilities

- improve aerosol characterization
- improve the gaseous retrievals of O<sub>3</sub>, H<sub>2</sub>O, and NO<sub>2</sub>
- add retrievals of temperature, pressure, NO<sub>3</sub>, and OCIO
- extend the vertical range of measurements
- provide a self-calibrating instrument independent of external data needed for retrieval
- expand the sampling coverage

This Data Products User's Guide (Version 1.1) provides a general description of the measurement technique, instrument, mission, and sampling coverage. The charge-coupled device (CCD) assignments for solar and lunar are described in Appendix A. Instructions for accessing the SAGE III Data Product files are also provided, and detailed descriptions of their content and format are provided in Appendices B through E.

More detailed information about the retrieval algorithms and validation activities are available at the EOS SAGE III web site:<sup>[2]</sup>

<http://eospso.gsfc.nasa.gov/atbd/sagetable.html>

Current information about the SAGE III

mission retrieval algorithms and an overview of the data processing are available at the SAGE III web site:<sup>[3]</sup>

<http://www-sage3.larc.nasa.gov/>

General information about the science objectives, the SAGE III mission, and the intended uses of its data products is available in the EOS Data Products Handbook: Volume 2 (Parkinson and Greenstone, 2000):<sup>[4,5]</sup>

<http://eospso.gsfc.nasa.gov/>

Specific details on changes to the different versions can be obtained from the SAGE III Version Description Documents and are available at the LASDC or the SAGE III web site:<sup>[3]</sup>

<http://www-sage3.larc.nasa.gov/>

**Note: Please review the Version Description Documents to ensure utilizing the correct version of the Data Products User's Guide for each data product version.**

## Measurement Technique

The SAGE III instrument measures the attenuation of solar radiation resulting from the scattering and absorption by atmospheric constituents in the Earth's atmosphere as the spacecraft observes a sunrise or sunset event. The enhanced capabilities of the SAGE III instrument allow similar measurements to be made during moonrise and moonset. The lunar measurements are made only during the second and third quarter phases of the Moon and when the atmosphere along the line-of-sight (LOS) is not directly illuminated by the Sun.

The viewing geometry of the satellite and the radiant target (Sun or Moon) during an occultation is illustrated in **Figure 1**. Measurement opportunities occur when the satellite ascends or descends from behind the Earth. Measurement begins when the instrument acquires the radiant target and uses a scanning mirror to scan the target image across the instrument field-of-view (FOV) aperture. A measurement is considered to occur at the point along the line of sight from the instrument to the target that comes closest to the Earth's surface (i.e., the subtangent point). The altitude of that point above the Earth's surface is commonly referred to as the tangent altitude.

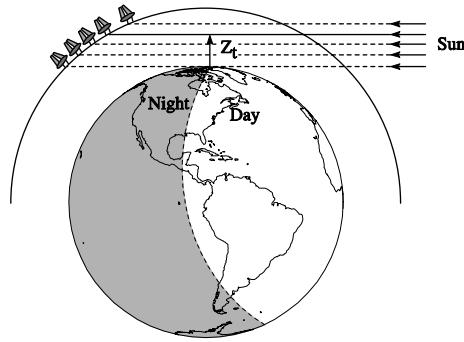


Figure 1. Occultation geometry.

The use of a scanning mirror provides multiple samples at each tangent altitude that are combined to construct transmission profiles from the Earth's surface (or cloud top) to an altitude of 100 km. Above this altitude, irradiance measurements are acquired between 100 and 300 km to characterize the instrument's performance across its wavelength range. This information is used to calibrate the instrument for each solar occultation event. By using this procedure, SAGE III data are relatively unaffected by changes in the instrument characteristics over the lifetime of the mission. A general description of the solar occultation measurement technique is provided by McCormick et al., 1979.[6]

The atmospheric extinction at any point along the line-of-sight typically includes contributions from aerosols and several gas constituents. **Figure 2** illustrates the principal extinction contributions for an altitude of 18 km. Both aerosol and molecular (Rayleigh) scattering contribute to extinction at all wavelengths. Ozone has strong absorption in the Hartley-Huggins band in the ultraviolet region of the spectrum and in the Chappius band in the visible spectrum. NO<sub>2</sub> absorbs between 350 and 600 nm. Water vapor has absorption lines throughout the visible spectrum, with an additional strong band near 940 nm. Although they are not depicted in this figure, NO<sub>3</sub> has absorption features between 500 and 650 nm, and OCIO has a strong band between 380 and 400 nm.

## Instrument Description and Operation

The design of the SAGE III sensor relies heavily upon the flight-proven designs used in the SAM II and SAGE I and II instruments. The SAGE III sensor assembly is illustrated in **Figure 3**. It consists of a pointing subsystem, an imaging subsystem, and a spectrometer. The pointing subsystem uses a scan mirror to acquire radiant energy from either the Sun or the Moon by

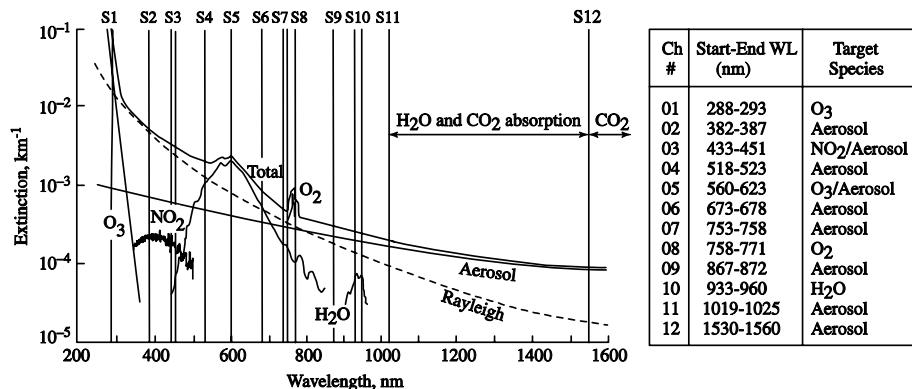


Figure 2. Principal extinction contributions at 18 km. Vertical lines (S1–S12) denote spectral bands measured during solar events by SAGE III.

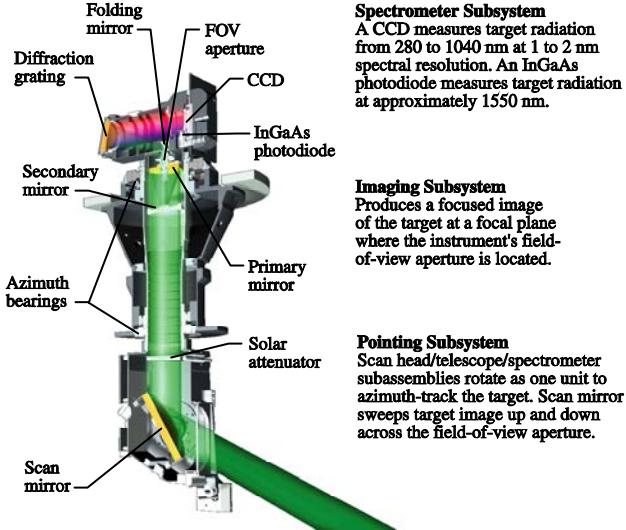


Figure 3. SAGE III sensor subsystems.

vertically scanning across the target's image. The imaging subsystem produces a focused image of the target at the focal plane where the science aperture is located. The aperture defines the instrument's instantaneous field of view (IFOV). A removable neutral-density filter is located along the optical path of this subsystem. The filter is inserted into the optical path to attenuate the solar signal by approximately a factor of  $10^6$  and is removed for lunar measurements.

The spectrometer is located behind the science aperture and uses an  $809 \times 10$  pixel charge-coupled device (CCD) array to measure target radiation. The solar radiance between 280 and 1040 nm is measured with a spectral resolution of 1 to 2 nm along the 809 pixel array. An additional Indium Gallium Arsenide (InGaAs) infrared (IR) photodiode measures light near 1550 nm with a bandwidth of 30 nm for near infrared aerosol extinction measurements. This spectral coverage permits the measurement of multiple absorption features of each gaseous species and multiwavelength measurements of broadband extinction by aerosols. In the present instrument configuration, 84 CCD pixel groups and the photodiode are divided among 12 solar channels, and 338 CCD pixel groups are divided among three lunar channels. The nominal solar and lunar SAGE III CCD pixel assignments are listed in

#### Appendix A.

For solar measurements, 3 pixels of the CCD (out of a total of 10 for each of the 809 wavelength segments) are averaged at 64 samples per second and result in an effective field-of-view (EFOV) of 30 arc seconds in the vertical and 1.5 arc minutes in the horizontal, which translates to a vertical resolution of 0.5 km and a horizontal resolution of 1.5 km at the tangent point location.

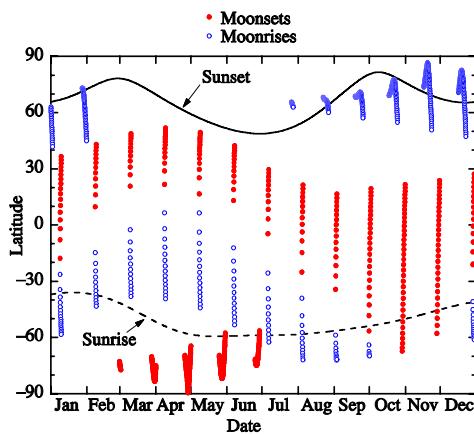
For lunar measurements, the measurement integration time is increased, the sample rate is decreased to 16 samples per second, and the EFOV is widened to include all 10 elements of the CCD to improve the signal-to-noise ratio. The increased integration time and slower sample rate result in an increase in the EFOV to 1 arc minute in the vertical (or 1 km at the tangent point). The use of all 10 pixels increases the horizontal view to 5 arc minutes (or 5 km at the tangent point).

## SAGE III Meteor-3M Mission

The SAGE III/Meteor-3M mission is a joint research experiment between NASA and the Russian Aviation and Space Agency (RASA).<sup>[7]</sup> Other instruments aboard the Meteor-3M provide hydrometeorological, heliogeophysical, and other types of data to organizations in Russia, Morocco, and Pakistan. Nominal sampling coverage for this

mission is shown in **Figure 4**. The satellite was launched on December 10, 2001 into a Sun-synchronous orbit at an altitude of 1020 km and with an approximate 9:00 a.m. equatorial crossing time. With these orbital parameters, solar occultation measurement opportunities will be limited to mostly high latitudes in the Northern Hemisphere (between 50° and 80° N) and mid-latitudes in the Southern Hemisphere (between 30° and 50° S).

Lunar observations extend over all latitudes, but with less dense coverage. These observations are limited by solar zenith angles >95° and beta angles < 40°.



*Figure 4. Nominal SAGE III/Meteor-3M coverage.*

## Data Products and Availability

A list of the profile measurements contained in the Science Data Products produced for the SAGE III mission is provided in **Table 1**. The reporting resolution for all species is 0.5 km.

A general description of the importance of measurements, as related to the Earth Science Enterprise's (ESE) Science Implementation Plan, is described in the EOS Science Plan (1999) and in the EOS Data Products Handbook, Volume 2 (2000).<sup>[4]</sup> These data products, with attendant metadata, are archived and available in either HDF-EOS or binary format from the

Langley Atmospheric Sciences Data Center (LASDC - formerly known as the LaRC Distributed Active Archive Center)<sup>[8]</sup> at

<http://eosweb.larc.nasa.gov/>

This data retrieval system allows the user to select Level 1B and Level 2 products based on specified periods of time and measurement locations. Most data products are organized into

Individual solar or lunar events (denoted as granules). The Level 2 Cloud product is a file that accumulates cloud data from solar events for a calendar month. SAGE III product files may be requested through the LASDC at any time. Software needed to ingest these products is also available at this web site.

## Product Content and Formats

This section provides a description of the content and format for the HDF-EOS and binary Level 1B and Level 2 data products. Format details for each product are listed in detail in Appendices B, C, D, and E. This section also provides a description of the file-naming convention. Please note that specific details on changes to the data processing algorithm and the data set format are contained in the SAGE III Data ‘Version Description Documents’, which are available at the LASDC. Please review the Version Description Documents to ensure utilizing the correct version of the Data Products User’s Guide for each data product version.

### Level 1B Transmission Product

The Level 1B Transmission product contains the SAGE III atmospheric slant path transmission profiles at 85 spectral channels, as listed in Appendix B. (Two additional spectral channels are embedded at pixel groups 23 and 24 in the transmission section of the product. These two groups contain CCD engineering data.) The profiles are skewed vertically and extend from sea level to an altitude of 100 km in 0.5 km intervals. The standard deviation of the binned transmission

Table 1. SAGE III Measurement Inventory

<b>Reported Measurement</b>	<b>Units</b>	<b>Vertical Range</b>	<b>Expected Precision</b>	<b>Product Residence</b>
<b>Transmission Profiles (@ 85 wavelengths)</b> Slant Path Transmission	none	0 - 100 km	0.05%	Level 1B Transmission
<b>Aerosol Profiles (@ 9 wavelength bands)</b> Extinction Stratospheric Optical Depth 1020nm Aerosol/Rayleigh Extinction Ratio	$\text{km}^{-1}$ none none	0 - 40 km	5%	Level 2 Solar
<b>Ozone Profiles (solar)</b> Concentration Slant Path Column Density	$\text{cm}^{-3}$ $\text{cm}^{-2}$	6 - 85 km	10%	Level 2 Solar
<b>Ozone Profiles (lunar)</b> Concentration	$\text{cm}^{-2}$	16 - 35 km	10%	Level 2 Lunar
<b>NO<sub>2</sub> Profiles (solar)</b> Concentration Slant Path Column Density	$\text{cm}^{-3}$ $\text{cm}^{-2}$	10 - 50 km	10%	Level 2 Solar
<b>NO<sub>2</sub> Profiles (lunar)</b> Concentration	$\text{cm}^{-3}$	20 - 50 km	10%	Level 2 Lunar
<b>Water Vapor Profiles</b> Concentration	$\text{cm}^{-3}$	0 - 50 km	5 - 15% (<5% below 33km)	Level 2 Solar
<b>NO<sub>3</sub> Profiles</b> Concentration	$\text{cm}^{-3}$	20 - 55 km	10%	Level 2 Lunar
<b>OCIO Profiles</b> Concentration	$\text{cm}^{-3}$	15 - 25 km	25%	Level 2 Lunar
<b>Temperature/Pressure Profiles</b> Temperature Profile Pressure Profile	K hPa	0 - 85 km 1000 - 0.004 hPa	2 K 2%	Level 2 Solar
<b>Cloud Presence Profile</b> Cloud Presence	none	0 - 30 km	not applicable	Level 2 Cloud

data is also provided for each reported altitude and channel. These data have been geolocated and normalized against exoatmospheric solar measurements to produce slant path transmission profiles. Algorithm retrievals outlined in the Algorithm Theoretical Basis Document (ATBD) are used to reduce and invert these data into the Level 2 products listed in Appendices C and D. The Level 1B product is only available for solar measurements.

In the construction of the transmission profiles, atmospheric density information is used to correct for refraction effects. This information is derived from temperature profiles interpolated to the location and time of each SAGE III event from

global gridded meteorological analyses provided by the National Oceanic and Atmospheric Administration's (NOAA's) National Center for Environmental Prediction (NCEP). These data extend from the surface to a pressure-altitude of 0.4 hPa (~55 km). Above this altitude, climatological temperature data are used from the Global Reference Atmospheric Model - 1995 (GRAM95, NASA Technical Memorandum 4715). The composite temperature profile information is included in the Level 1B data product.

Note that the NCEP temperature product is also used to correct for molecular scattering in the Level 2 retrieval algorithm. The retrieval of

temperature directly from the SAGE III solar measurements occurs later, downstream in the data processing flow, and is reported in the Level 2 products.

## Level 2 Solar Species Products

The Level 2 Solar Species products are produced from the Level 1B Transmission profiles by using algorithms described in the ATBD. A description of the Level 2 Solar Species format is provided in Appendices C and D. This section discusses the content of the Level 2 Solar Species organized by species. Each species includes information on its relative uncertainty. Species are reported in profiles on a geometric altitude coordinate system with a vertical resolution of 0.5 km. Diurnal corrections are not applied to the retrieved constituent values.

### Aerosol

Profiles of aerosol extinction are provided at 9 wavelengths (385, 448, 521, 596, 676, 754, 868, 1019, and  $\sim$ 1550 nm) from the surface or opaque cloud top to an altitude of 40 km, where the contribution due to aerosols becomes negligible at all wavelengths. In practice, the lower altitude of an aerosol extinction profile may be limited by the dynamic range of the detector and a high, integrated slant path optical depth. This detection limit occurs near a slant path optical depth of about 8, which translates to a column optical depth of approximately 0.02.

Two additional aerosol products are provided in this list: stratospheric aerosol optical depth and the ratio of aerosol extinction to the contribution caused by molecular scattering at a wavelength of 1019 nm.

Stratospheric optical depth values are only provided for profiles that extend below the altitude of the tropopause.

Aerosol extinction profiles are derived as a residual following the clearing of previously determined contributions of molecular scattering

and absorption due to the presence of ozone and nitrogen dioxide. The ATBD contains a full discussion of this process.

### Water Vapor

Profiles of water vapor are provided in units of concentration from the surface to an altitude of 50 km. A temperature profile retrieved from SAGE III measurements or from a gridded analysis will facilitate computation of relative humidity. The water vapor products are retrieved by using a nonlinear least-squares approach from the solar occultation measurements of slant path absorption.

### Nitrogen Dioxide

Profiles of nitrogen dioxide are provided in units of concentration from the tropopause to an altitude of 50 km. These profile measurements are derived from the multiple linear regression retrieval algorithm as described in the ATBD.

### Ozone

Four different profiles of ozone are provided in units of concentration over the altitude range 6 to 85 km. One profile is based upon measurements made at short wavelengths in the Hartley-Huggins band (denoted Mesospheric Ozone), a second profile is based upon measurements made at visible wavelengths in the Chappius band (denoted Multiple Linear Regression Ozone) and a third profile is obtained using a similar approach utilized to process SAGE II data (denoted Least Squares Ozone). The fourth product consists of a composite profile constructed of data from the Chappius band at lower altitudes (below about 30 km) and is blended with data from the SAGE II-like Ozone retrieval ( $\sim$ 30 to  $\sim$ 47 km) and with measurements from the Hartley-Huggins band at higher altitudes (above approximately 47 km). Details on the exact interpolation altitude are provided in the SAGE III Data Version Description Documents. For each of the different ozone products slant-path column density profiles are also included.

### ***Temperature and Pressure***

The retrieved profiles of temperature and pressure are new products provided by the SAGE III mission. Besides providing a valuable scientific measurement, these data will permit a self-consistent determination of molecular scattering along the limb view, which is needed for accurate retrievals of ozone and other species. These observations are derived from radiance measurements over the oxygen A-band feature centered near 762 nm, as described in the ATBD. This product is not to be confused with the temperature and pressure profiles obtained from the NCEP gridded analysis that is used in the construction of Level 1B Transmission profiles.

### **Level 2 Cloud Product (from solar data)**

The SAGE III instrument detects subvisible and opaque clouds by using measurements of aerosol extinction and their uncertainties at wavelengths of 525, 1020, and 1550 nm. (See the ATBD and Appendix D.) By definition, opaque clouds block sunlight to the instrument. In regions where the lower altitude limit of a SAGE III profile does not intersect the surface, this altitude limit is set at the opaque cloud top altitude. In periods of heavy aerosol loading, however, there is no unambiguous way to determine the difference between opaque cloud termination and heavy aerosol layer termination. Subvisible clouds, on the other hand, have extinction coefficients within the SAGE III measurement range and therefore do not cause the profiles to terminate above the surface.

The basic product consists of three vertical profiles extending from 0 to 30 km that contain information on the presence of clouds at 0.5 km intervals. The first profile indicates the presence of clouds. The second profile provides information on the relative uncertainty of the observation, while the third profile provides a cloud area index that gives guidance concerning the derivation of the uncertainty. Unlike all other Level 2 products, a granule of this product contains a collection of cloud data for one calendar month.

The cloud presence information is denoted by an index at each altitude, whose value is set as follows:

- 0 Insufficient input data (i.e., data missing for at least one aerosol wavelength)
- 1 No cloud present – under all aerosol conditions
- 2 No cloud present – should not occur under background aerosol conditions; ambiguous under moderate to intense volcanic aerosol conditions
- 3 Cloud present – should not occur under background aerosol conditions; ambiguous under moderate to intense aerosol volcanic conditions
- 4 Cloud present – under all aerosol conditions

The uncertainty information is given by the indices as follows:

- 0 Insufficient input data
- 1 The limits of error attached to the aerosol extinction values used in the algorithm are such that the determination of the cloud presence index value can be made with confidence.
- 2 The limits of error attached to the aerosol extinction values used in the algorithm are such that the determination of the cloud presence index value cannot be made with confidence.
- 3 Data location on the profile (e.g., a data point located below a strong but opaque cloud layer) is such that the determination of cloud presence cannot be made with confidence.
- 4 Atmospheric conditions are such (e.g. volcanic aerosol present) that the wavelength extinction characteristics of the aerosol are too close to that of the cloud for the algorithm to work satisfactorily.

The cloud area index is a four-digit number that shows the regions of the plot (see figures 3.2.3 and 3.6.2 in the Cloud ATBD) over which the error ellipse extends. An index of 0230 signifies that the ellipse extends over regions 2 and 3 of these plots; an index of 1200 signifies that the ellipse extends over regions 1 and 2. The index is assigned for all nonzero values of the cloud uncertainty flag; it has a value of 0000 if there is insufficient or nonphysical input data.

## Level 2 Lunar Species Products

The retrieval of constituent profiles from irradiance measurements acquired during lunar occultation events is a new capability for the SAGE III experiment. These retrievals are more complex than those employed for solar events because they account for the spatial and spectral nonuniformity of the surface albedo of the moon and the much lower measurement signal. One important difference between the solar and lunar retrieval techniques is the absence of a Level 1B slant path transmission profile product for lunar occultation retrievals, a consequence of not being able to determine limb-darkening curves with sufficient accuracy to calibrate each SAGE III lunar occultation event. The inaccuracies in the registration of the limb-darkening curve arise from small uncertainties in the pointing knowledge of the instrument in the presence of large variations of the surface albedo across the lunar surface.

As a result of these issues, the reduction and retrieval of the lunar Level 2 products use a different approach that requires the separation of the broadband spectral characteristics of the lunar albedo. Next, a multiple linear regression retrieval technique is employed on the residual high-frequency component of the spectra to produce the Level 2 products. Details of the data reduction and inversion techniques are provided in the ATBD. The lunar product format and content details are provided in Appendix E.

Due to the increased instrument integration time for this mode of operation, the resulting single-scan vertical resolution of the lunar Level 2

products is 1 km. The chemical species concentration data from multiple scans are bin-averaged and reported on a geometric coordinate system with a vertical resolution of 0.5 km to maintain grid spacing compatibility with the solar Level 2 products.

A description of the content of these products is provided below and organized by species. Each product includes information on its relative uncertainty and a data quality assurance flag set. Diurnal corrections are not applied to the retrieved constituent values.

### ***Chlorine Dioxide***

Profiles of chlorine dioxide are provided in units of concentration for an altitude range of 15 - 25 km. These profile measurements are derived from the multiple linear regression retrieval algorithm described in the ATBD.

### ***Nitrogen Dioxide***

Profiles of nitrogen dioxide are provided in units of concentration from 20 to 50 km. These profile measurements are derived from the multiple linear regression retrieval algorithm described in the ATBD.

### ***Nitrogen Trioxide***

Profiles of nitrogen trioxide are provided in units of concentration for the altitude range of 20 - 55 km. These profile measurements are derived from the multiple linear regression retrieval algorithm described in the ATBD.

### ***Ozone***

Profiles of ozone based upon measurements made at visible wavelengths in the Chappius band are provided in units of concentration from 16 to 35 km.

## **File-Naming Convention**

Following is a list of products and the file-naming convention for each product that shall be

generated by SAGE III SCF processing. **Note:** Refer to the Version Description Documents to ensure utilizing the correct version of the Data Products User's Guide for each data product version.

- **L1B Solar Transmission Binary Products:**  
g3a.tb.{xxxxxxXXvzz.zz}  
g3a.tbm.{xxxxxxXXvzz.zz}
- **L1B Solar Transmission HDF Products:**  
g3a.t.{xxxxxxXXvzz.zz}  
g3a.tm.{xxxxxxXXvzz.zz}
- **Level 2 Solar Binary Products:**  
g3a.sspb.{xxxxxxXXvzz.zz}  
g3a.sspbm.{xxxxxxXXvzz.zz}
- **Level 2 Solar HDF Products:**  
g3a.ssp.{xxxxxxXXvzz.zz}  
g3a.sppm.{xxxxxxXXvzz.zz}
- **Level 2 Lunar Binary Products:**  
g3a.lspb.{xxxxxxXXvzz.zz}  
g3a.lspbm.{xxxxxxXXvzz.zz}
- **Level 2 Lunar HDF Products:**  
g3a.lsp.{xxxxxxXXvzz.zz}  
g3a.lspm.{xxxxxxXXvzz.zz}
- **Level 2 Cloud Binary Products:**  
g3a.cldb.{xxxxxxXXvzz.zz}  
g3a.clfdbm.{xxxxxxXXvzz.zz}
- **Level 2 Cloud HDF Products:**  
g3a.cld.{xxxxxxXXvzz.zz}  
g3a.cldm.{xxxxxxXXvzz.zz}

where:

<b>b</b>	binary
<b>m</b>	metadata
<b>t</b>	Level 1B transmission profiles
<b>ssp</b>	Level 2 Solar species profiles
<b>lsp</b>	Level 2 Lunar species profiles
<b>cld</b>	Level 2 Cloud product
{xxxxxxXX}	Event ID (6 digit orbit number, 2 digit event type: where 10 = sunrise, 20 = sunset, 30 = moonrise, 40 = moonset)
{vzz.zz}	Software version number

**Example:** g3a.tb.00191820v00.92

Refers to a transmission binary file for SAGE III Meteor-3M captured during a sunset for orbit 1918 and released as a product of SCF Software Version 00.92.

**Example:** g3a.ssp.00185110v00.92

Refers to a solar hdf file for SAGE III Meteor-3M captured during a sunrise for orbit 1851 and released as a product of SCF Software Version 00.92.

**Example:** g3a.lspbm.00187730v00.92

Refers to a lunar binary metadata file for SAGE III Meteor-3M captured during a moonrise for orbit 1877 and released as a product of SCF Software Version 00.92.

**Example:** g3a.cld.199901v00.92

Refers to a cloud hdf file for SAGE III Meteor-3M for January 1999 and released as a product of SCF Software Version 00.92.

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<http://eosweb.larc.nasa.gov/> Accessed Nov. 6, 2001.

# Appendix A

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## SAGE III Nominal CCD Pixel Assignments

**Table A1. Nominal CCD Assignments for Solar Data Collection**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
001	31	287.539	36	293.160	290.349	Mesospheric O <sub>3</sub>	5-pixel average
002	132	382.204	136	386.893	384.548	Aerosol Ch. 1/Rayleigh Ext.	5-pixel average
003	186	432.848	186	433.786	433.317	NO <sub>2</sub> Gas	
004	187	433.786	187	434.724	434.255	NO <sub>2</sub> Gas	
005	188	434.724	188	435.662	435.193	NO <sub>2</sub> Gas	
006	189	435.662	189	436.601	436.132	NO <sub>2</sub> Gas	
007	190	436.601	190	437.539	437.070	NO <sub>2</sub> Gas	
008	191	437.539	191	438.477	438.008	NO <sub>2</sub> Gas	
009	192	438.477	192	439.415	438.946	NO <sub>2</sub> Gas	
010	193	439.415	193	440.353	439.884	NO <sub>2</sub> Gas	
011	194	440.353	194	441.291	440.822	NO <sub>2</sub> Gas	
012	195	441.291	195	442.229	441.760	NO <sub>2</sub> Gas	
013	196	442.229	196	443.167	442.698	NO <sub>2</sub> Gas	
014	197	443.167	197	444.105	443.636	NO <sub>2</sub> Gas	
015	198	444.105	198	445.044	444.575	NO <sub>2</sub> Gas	
016	199	445.044	199	445.982	445.51	NO <sub>2</sub> Gas	
017	200	445.982	200	446.920	446.451	NO <sub>2</sub> Gas	
018	201	446.920	201	447.858	447.389	Aerosol Channel 2/ NO <sub>2</sub> Gas	Science pixel numbers 18, 19, 20 and 21 are averaged together to form Aerosol Channel 2.
019	202	447.858	202	448.796	448.327	Aerosol Channel 2/ NO <sub>2</sub> Gas	
020	203	448.796	203	449.734	449.265	Aerosol Channel 2/ NO <sub>2</sub> Gas	
021	204	449.734	204	450.673	450.204	Aerosol Channel 2/ NO <sub>2</sub> Gas	
022	277	518.242	281	522.936	520.589	Aerosol Channel 3	5-pixel average
023						Engineering	
024						Engineering	
025	322	560.492	324	563.322	561.907	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
026	329	567.094	331	569.924	568.509	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
027	336	573.697	338	576.524	575.110	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
028	343	580.297	345	583.125	581.711	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)

**Table A1. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
029	350	586.896	352	589.723	588.309	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
030	357	593.493	359	596.320	594.906	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
031	364	600.089	366	602.916	601.503	Aerosol Channel 4/ O <sub>3</sub> Gas	3-pixel sum (Primary AerChannel4)
032	371	606.684	373	609.510	608.097	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
033	378	613.277	380	616.103	614.690	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
034	385	619.870	387	622.694	621.282	O <sub>3</sub> Gas	3-pixel sum (Alternate AerCh.4)
035	442	673.499	446	678.199	675.849	Aerosol Channel 5	3-pixel sum (Alternate AerCh.4)
036	527	753.306	531	757.995	755.650	Aerosol Channel 6	5-pixel average
037	532	757.995	532	758.932	758.463	O <sub>2</sub> A-Band	5-pixel average
038	533	758.932	533	759.870	759.401	O <sub>2</sub> A-Band	
039	534	759.870	534	760.807	760.339	O <sub>2</sub> A-Band	
040	535	760.807	535	761.725	761.276	O <sub>2</sub> A-Band	
041	536	761.725	536	762.644	762.175	O <sub>2</sub> A-Band	
042	537	762.644	537	763.581	763.113	O <sub>2</sub> A-Band	
043	538	763.581	538	764.519	764.050	O <sub>2</sub> A-Band	
044	539	764.519	539	765.456	764.988	O <sub>2</sub> A-Band	
045	540	765.456	540	766.393	765.925	O <sub>2</sub> A-Band	
046	541	766.393	541	767.331	766.862	O <sub>2</sub> A-Band	
047	542	767.331	542	768.268	767.800	O <sub>2</sub> A-Band	
048	543	768.268	543	769.206	768.737	O <sub>2</sub> A-Band	
049	544	769.206	544	770.143	769.674	O <sub>2</sub> A-Band	
050	545	770.143	545	771.079	770.611	O <sub>2</sub> A-Band	
051	649	867.273	653	871.927	869.600	Aerosol Channel 7	
052	720	933.215	720	934.141	933.678	Water Vapor	5-pixel average
053	721	934.141	721	935.068	934.605	Water Vapor	
054	722	935.068	722	935.995	935.532	Water Vapor	
055	723	935.995	723	936.922	936.458	Water Vapor	
056	724	936.922	724	937.848	937.385	Water Vapor	

**Table A1. Concluded**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
057	725	937.848	725	938.774	938.311	Water Vapor	
058	726	938.774	726	939.700	939.237	Water Vapor	
059	727	939.700	727	940.627	940.163	Water Vapor	
060	728	940.627	728	941.553	941.090	Water Vapor	
061	729	941.553	729	942.479	942.016	Water Vapor	
062	730	942.479	730	943.405	942.942	Water Vapor	
063	731	943.405	731	944.331	943.868	Water Vapor	
064	732	944.331	732	945.257	944.794	Water Vapor	
065	733	945.257	733	946.183	945.720	Water Vapor	
066	734	946.183	734	947.109	946.646	Water Vapor	
067	735	947.109	735	948.034	947.571	Water Vapor	
068	736	948.034	736	948.960	948.497	Water Vapor	
069	737	948.960	737	949.885	949.423	Water Vapor	
070	738	949.885	738	950.811	950.348	Water Vapor	
071	739	950.811	739	951.737	951.274	Water Vapor	
072	740	951.737	740	952.662	952.200	Water Vapor	
073	741	952.662	741	953.588	953.125	Water Vapor	
074	742	953.588	742	954.513	954.050	Water Vapor	
075	743	954.513	743	955.438	954.976	Water Vapor	
076	744	955.438	744	956.364	955.901	Water Vapor	
077	745	956.364	745	957.288	956.826	Water Vapor	
078	746	957.288	746	958.214	957.751	Water Vapor	
079	747	958.214	747	959.139	958.676	Water Vapor	
080	748	959.139	748	960.063	959.601	Water Vapor	
081	803	1019.143	803	1020.065	1019.604	Aerosol Channel 8	
082	804	1020.065	804	1020.987	1020.526	Aerosol Channel 8	
083	805	1020.987	805	1021.907	1021.447	Aerosol Channel 8	
084	806	1021.907	806	1022.828	1022.368	Aerosol Channel 8	
085	807	1022.828	807	1023.750	1023.289	Aerosol Channel 8	
086	808	1023.750	808	1024.670	1024.210	Aerosol Channel 8	Science pixel numbers 81, 82, 83, 84, 85 and 86 are averaged together to form Aerosol Channel 8.

**Table A2. Nominal CCD Assignments for Lunar Data Collection**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
001	130	380.05	130	380.99	380.52	O <sub>3</sub> , NO <sub>2</sub> , NO <sub>3</sub> , and OCIO are measured using science pixel 1 through science pixel 91.	Science pixel 1 through science pixel 294 contain single CCD pixels.
002	131	380.99	131	381.92	381.46		
003	132	381.92	132	382.86	382.39		
004	133	382.86	133	383.80	383.33		
005	134	383.80	134	384.74	384.27		
006	135	384.74	135	385.68	385.21		
007	136	385.68	136	386.61	386.15		
008	137	386.61	137	387.55	387.08		
009	138	387.55	138	388.49	388.02		
010	139	388.49	139	389.43	388.96		
011	140	389.43	140	390.36	389.90		
012	141	390.36	141	391.30	390.83		
013	142	391.30	142	392.24	391.77		
014	143	392.24	143	393.18	392.71		
015	144	393.18	144	394.11	393.65		
016	145	394.11	145	395.05	394.58		
017	146	395.05	146	395.99	395.52		
018	147	395.99	147	396.93	396.46		
019	148	396.93	148	397.87	397.40		
020	149	397.87	149	398.80	398.34		
021	150	398.80	150	399.74	399.27		
022	151	399.74	151	400.68	400.21		
023	152	400.68	152	401.62	401.15		
024	153	401.62	153	402.55	402.09		
025	154	402.55	154	403.49	403.02		
026	155	403.49	155	404.43	403.96		
027	156	404.43	156	405.37	404.90		
028	157	405.37	157	406.31	405.84		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
029	158	406.31	158	407.24	406.78	O <sub>3</sub> , NO <sub>2</sub> , NO <sub>3</sub> , and OCIO are measured using science pixel 1 through science pixel 91.	Science pixel 1 through science pixel 294 contain single CCD pixels.
030	169	416.62	169	417.56	417.09		
031	170	417.56	170	418.50	418.03		
032	171	418.50	171	419.44	418.97		
033	172	419.44	178	420.38	419.91		
034	173	420.38	179	421.31	420.85		
035	174	421.31	180	422.25	421.78		
036	175	422.25	181	423.19	422.72		
037	176	423.19	182	424.13	423.66		
038	177	424.13	183	425.07	424.60		
039	178	425.07	184	426.00	425.54		
040	179	426.00	185	426.94	426.47		
041	180	426.94	186	427.88	427.41		
042	181	427.88	187	428.82	428.35		
043	182	428.82	188	429.76	429.29		
044	183	429.76	189	430.69	430.23		
045	184	430.69	190	431.63	431.16		
046	185	431.63	191	432.57	432.10		
047	186	432.57	192	433.51	433.04		
048	187	433.51	193	434.45	433.98		
049	188	434.45	194	435.38	434.92		
050	189	435.38	195	436.32	435.85		
051	190	436.32	196	437.26	436.79		
052	191	437.26	197	438.20	437.73		
053	192	438.20	198	439.14	438.67		
054	193	439.14	199	440.07	439.61		
055	194	440.07	200	441.01	440.54		
056	195	441.01	201	441.95	441.48		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
057	196	441.95	196	442.89	442.42	O <sub>3</sub> , NO <sub>2</sub> , NO <sub>3</sub> , and OCIO are measured using science pixel 1 through science pixel 91.	Science pixel 1 through science pixel 294 contain single CCD pixels.
058	197	442.89	197	443.83	443.36		
059	198	443.83	198	444.77	444.30		
060	199	444.77	199	445.70	445.24		
061	200	445.70	200	446.64	446.17		
062	201	446.64	201	447.58	447.11		
063	202	447.58	202	448.52	448.05		
064	203	448.52	203	449.46	448.99		
065	204	449.46	204	450.39	449.93		
066	205	450.39	205	451.33	450.86		
067	206	451.33	206	452.27	451.80		
068	207	452.27	207	453.21	452.74		
069	208	453.21	208	454.15	453.68		
070	209	454.15	209	455.09	454.62		
071	210	455.09	210	456.02	455.56		
072	211	456.02	211	456.96	456.49		
073	212	456.96	212	457.90	457.43		
074	213	457.90	213	458.84	458.37		
075	214	458.84	214	459.78	459.31		
076	215	459.78	215	460.71	460.25		
077	216	460.71	216	461.65	461.18		
078	217	461.65	217	462.59	462.12		
079	218	462.59	218	463.53	463.06		
080	219	463.53	219	464.47	464.00		
081	220	464.47	220	465.41	464.94		
082	221	465.41	221	466.35	465.88		
083	222	466.35	222	467.28	466.82		
084	223	467.28	223	468.22	467.75		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
085	224	468.22	224	469.16	468.69	O <sub>3</sub> , NO <sub>2</sub> , NO <sub>3</sub> , and OCIO are measured using science pixel 1 through science pixel 91.	Science pixel 1 through science pixel 294 contains single CCD pixels.
086	225	469.16	225	470.10	469.63		
087	226	470.10	226	471.04	470.57		
088	227	471.04	227	471.98	471.51		
089	228	471.98	228	472.91	472.45		
090	229	472.91	229	473.85	473.38		
091	230	473.85	230	474.79	474.32		
092	231	474.79	231	475.73	475.26	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	
093	232	475.73	232	476.67	476.20		
094	233	476.67	233	477.61	477.14		
095	234	477.61	234	478.54	478.08		
096	235	478.54	235	479.48	479.01		
097	236	479.48	236	480.42	479.95		
098	237	480.42	237	481.36	480.89		
099	238	481.36	238	482.30	481.83		
100	239	482.30	239	483.24	482.77		
101	240	483.24	240	484.17	483.71		
102	241	484.17	241	485.11	484.64		
103	242	485.11	242	486.05	485.58		
104	243	486.05	243	486.99	486.52		
105	244	486.99	244	487.93	487.46		
106	245	487.93	245	488.87	488.40		
107	246	488.87	246	489.81	489.34		
108	247	489.81	247	490.74	490.28		
109	258	500.13	258	501.07	500.60		
110	259	501.07	259	502.01	501.54		
111	260	502.01	260	502.95	502.48		
112	261	502.95	261	503.88	503.42		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
113	262	503.88	262	504.82	504.35	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contains single CCD pixels.
114	263	504.82	263	505.76	505.29		
115	264	505.76	264	506.70	506.23		
116	265	506.70	265	507.64	507.17		
117	266	507.64	266	508.58	508.11		
118	267	508.58	267	509.52	509.05		
119	268	509.52	268	510.46	509.99		
120	269	510.46	269	511.39	510.93		
121	270	511.39	270	512.33	511.86		
122	271	512.33	271	513.27	512.80		
123	272	513.27	272	514.21	513.74		
124	273	514.21	273	515.15	514.68		
125	274	515.15	274	516.09	515.62		
126	275	516.09	275	517.03	516.56		
127	276	517.03	276	517.97	517.50		
128	277	517.97	277	518.90	518.44		
129	278	518.90	278	519.84	519.37		
130	279	519.84	279	520.78	520.31		
131	280	520.78	280	521.72	521.25		
132	281	521.72	281	522.66	522.19		
133	282	522.66	282	523.60	523.13		
134	283	523.60	283	524.54	524.07		
135	284	524.54	284	525.48	525.01		
136	285	525.48	285	526.41	525.95		
137	286	526.41	286	527.35	526.88		
138	287	527.35	287	528.29	527.82		
139	288	528.29	288	529.23	528.76		
140	289	529.23	289	530.17	529.70		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
141	290	530.17	290	531.11	530.64	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contain single CCD pixels.
142	291	531.11	291	532.05	531.58		
143	292	532.05	292	532.99	532.52		
144	293	532.99	293	533.92	533.46		
145	294	533.92	294	534.86	534.39		
146	295	534.86	295	535.80	535.33		
147	296	535.80	296	536.74	536.27		
148	297	536.74	297	537.68	537.21		
149	298	537.68	298	538.62	538.15		
150	299	538.62	299	539.56	539.09		
151	300	539.56	300	540.50	540.03		
152	301	540.50	301	541.44	540.97		
153	302	541.44	302	542.38	541.91		
154	303	542.38	303	543.31	542.85		
155	304	543.31	304	544.25	543.78		
156	305	544.25	305	545.19	544.72		
157	306	545.19	306	546.13	545.66		
158	307	546.13	307	547.07	546.60		
159	308	547.07	308	548.01	547.54		
160	309	548.01	309	548.95	548.48		
161	310	548.95	310	549.89	549.42		
162	315	553.64	315	554.58	554.11		
163	316	554.58	316	555.52	555.05		
164	317	555.52	317	556.46	555.99		
165	318	556.46	318	557.40	556.93		
166	319	557.40	319	558.34	557.87		
167	320	558.34	320	559.28	558.81		
168	321	559.28	321	560.2292	559.75		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
169	322	560.22	322	561.17	560.70	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contain single CCD pixels.
170	323	561.17	323	562.11	561.64		
171	324	562.11	324	563.06	562.59		
172	325	563.06	325	564.00	563.53		
173	326	564.00	326	564.94	564.47		
174	327	564.94	327	565.89	565.42		
175	328	565.89	328	566.83	566.36		
176	329	566.83	329	567.77	567.30		
177	330	567.77	330	568.71	568.24		
178	331	568.71	331	569.66	569.19		
179	332	569.66	332	570.60	570.13		
180	333	570.60	333	571.54	571.07		
181	334	571.54	334	572.49	572.02		
182	335	572.49	335	573.43	572.96		
183	336	573.43	336	574.37	573.90		
184	337	574.37	337	575.32	574.85		
185	338	575.32	338	576.26	575.79		
186	339	576.26	339	577.20	576.73		
187	340	577.20	340	578.14	577.67		
188	341	578.14	341	579.09	578.62		
189	342	579.09	342	580.03	579.56		
190	343	580.03	343	580.97	580.50		
191	344	580.97	344	581.92	581.45		
192	345	581.92	345	582.86	582.39		
193	346	582.86	346	583.80	583.33		
194	347	583.80	347	584.74	584.27		
195	348	584.74	348	585.69	585.22		
196	349	585.69	349	586.63	586.16		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
197	350	586.63	350	587.57	587.10	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contain single CCD pixels.
198	351	587.57	351	588.52	588.05		
199	352	588.52	352	589.46	588.99		
200	353	589.46	353	590.40	589.93		
201	354	590.40	354	591.34	590.87		
202	355	591.34	355	592.29	591.82		
203	356	592.29	356	593.23	592.76		
204	357	593.23	357	594.17	593.70		
205	358	594.17	358	595.11	594.64		
206	359	595.11	359	596.05	595.58		
207	360	596.05	360	597.00	596.53		
208	361	597.00	361	597.94	597.47		
209	362	597.94	362	598.88	598.41		
210	363	598.88	363	599.82	599.35		
211	364	599.82	364	600.77	600.30		
212	365	600.77	365	601.71	601.24		
213	366	601.71	366	602.65	602.18		
214	367	602.65	367	603.59	603.12		
215	368	603.59	368	604.53	604.06		
216	369	604.53	369	605.48	605.01		
217	370	605.48	370	606.42	605.95		
218	371	606.42	371	607.36	606.89		
219	372	607.36	372	608.30	607.83		
220	373	608.30	373	609.24	608.77		
221	374	609.24	374	610.19	609.72		
222	375	610.19	375	611.13	610.66		
223	376	611.13	376	612.07	611.60		
224	377	612.07	377	613.01	612.54		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
225	378	613.01	378	613.95	613.48	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contain single CCD pixels.
226	379	613.95	379	614.90	614.43		
227	380	614.90	380	615.84	615.37		
228	381	615.84	381	616.78	616.31		
229	382	616.78	382	617.72	617.25		
230	383	617.72	383	618.66	618.19		
231	384	618.66	384	619.61	619.14		
232	385	619.61	385	620.55	620.08		
233	386	620.55	386	621.49	621.02		
234	387	621.49	387	622.42	621.96		
235	388	622.42	388	623.36	622.89		
236	389	623.36	389	624.30	623.83		
237	390	624.30	390	625.24	624.77		
238	391	625.24	391	626.19	625.72		
239	392	626.19	392	627.13	626.66		
240	393	627.13	393	628.07	627.60		
241	394	628.07	394	629.01	628.54		
242	395	629.01	395	629.95	629.48		
243	396	629.95	396	630.89	630.42		
244	397	630.89	397	631.83	631.36		
245	398	631.83	398	632.78	632.31		
246	399	632.78	399	633.72	633.25		
247	400	633.72	400	634.66	634.19		
248	401	634.66	401	635.60	635.13		
249	402	635.60	402	636.54	636.07		
250	403	636.54	403	637.48	637.01		
251	404	637.48	404	638.42	637.95		
252	405	638.42	405	639.36	638.89		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
253	406	639.36	406	640.31	639.84	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contain single CCD pixels.
254	407	640.31	407	641.25	640.78		
255	408	641.25	408	642.19	641.72		
256	409	642.19	409	643.13	642.66		
257	410	643.13	410	644.07	643.60		
258	411	644.07	411	645.01	644.54		
259	412	645.01	412	645.95	645.48		
260	413	645.95	413	646.89	646.42		
261	414	646.89	414	647.83	647.36		
262	415	647.83	415	648.77	648.30		
263	416	648.77	416	649.71	649.24		
264	417	649.71	417	650.65	650.18		
265	418	650.65	418	651.60	651.13		
266	419	651.60	419	652.54	652.07		
267	420	652.54	420	653.48	653.01		
268	421	653.48	421	654.42	653.95		
269	422	654.42	422	655.36	654.89		
270	423	655.36	423	656.30	655.83		
271	424	656.30	424	657.24	656.77		
272	425	657.24	425	658.18	657.71		
273	426	658.18	426	659.12	658.65		
274	427	659.12	427	660.06	659.59		
275	428	660.06	428	661.00	660.53		
276	429	661.00	429	661.94	661.47		
277	430	661.94	430	662.88	662.41		
278	431	662.88	431	663.82	663.35		
279	432	663.82	432	664.76	664.29		
280	433	664.76	433	665.70	665.23		

**Table A2. Continued**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
281	434	665.70	434	666.64	666.17	O <sub>3</sub> , NO <sub>2</sub> , and NO <sub>3</sub> , are measured using science pixel 92 through science pixel 294.	Science pixel 1 through science pixel 294 contain single CCD pixels.
282	435	666.64	435	667.58	667.11		
283	436	667.58	436	668.52	668.05		
284	437	668.52	437	669.46	668.99		
285	438	669.46	438	670.40	669.93		
286	439	670.40	439	671.34	670.87		
287	440	671.34	440	672.28	671.81		
288	441	672.28	441	673.23	672.76		
289	442	673.23	442	674.17	673.70		
290	443	674.17	443	675.11	674.64		
291	444	675.11	444	676.05	675.58		
292	445	676.05	445	676.99	676.52		
293	446	676.99	446	677.93	677.46		
294	447	677.93	447	678.87	678.40		
295	448	678.87	448	679.80	679.34	O <sub>2</sub> B-band science pixels 295 through 313 are not currently utilized.	1-pixel average
296	449	679.80	449	680.74	680.27		1-pixel average
297	450	680.74	450	681.68	681.21		1-pixel average
298	451	681.68	451	682.62	682.15		1-pixel average
299	452	682.62	452	683.56	683.09		1-pixel average
300	453	683.56	453	684.50	684.03		1-pixel average
301	454	684.50	454	685.44	684.97		1-pixel average
302	455	685.44	455	686.38	685.91		1-pixel average
303	456	686.38	456	687.32	686.85		1-pixel average
304	457	687.32	457	688.26	687.79		1-pixel average
305	458	688.26	458	689.20	688.73		1-pixel average
306	459	689.20	459	690.14	689.67		1-pixel average
307	460	690.14	460	691.08	690.61		1-pixel average
308	461	691.08	461	692.02	691.55		1-pixel average

**Table A2. Concluded**

Science Pixel Group	CCD Start Pixel	Start Wavelength (nm)	CCD End Pixel	End Wavelength (nm)	Centerline Wavelength	Measured Parameter	Comment
309	462	692.02	462	692.96	692.49	$O_2$ B-band science pixels 295 through 313 are not currently utilized.	1-pixel average
310	463	692.96	463	693.90	693.43		1-pixel average
311	464	693.90	464	694.84	694.37		1-pixel average
312	465	694.84	465	695.78	695.31		
313	466	695.78	466	696.72	696.25		
314	528	753.97	528	755.85	754.91	$O_2$ A-band science pixels 314 through 338 are not currently utilized.	2-pixel average
315	530	755.85	530	757.72	756.79		2-pixel average
316	532	757.72	532	758.66	758.19		1-pixel average
317	533	758.66	533	759.60	759.13		1-pixel average
318	534	759.60	534	760.54	760.07		1-pixel average
319	535	760.54	535	761.45	761.00		1-pixel average
320	536	761.45	536	762.37	761.91		1-pixel average
321	537	762.37	537	763.31	762.84		1-pixel average
322	538	763.31	538	764.25	763.78		1-pixel average
323	539	764.25	539	765.18	764.72		1-pixel average
324	540	765.18	540	766.12	765.65		1-pixel average
325	541	766.12	541	767.06	766.59		1-pixel average
326	542	767.06	542	768.00	767.53		1-pixel average
327	543	768.00	543	768.93	768.47		1-pixel average
328	544	768.93	544	769.87	769.40		1-pixel average
329	545	769.87	545	770.81	770.34		1-pixel average
330	546	770.81	546	771.74	771.28		1-pixel average
331	547	771.74	547	772.68	772.21		1-pixel average
332	548	772.68	548	773.62	773.15		1-pixel average
333	549	773.62	549	774.56	774.09		1-pixel average
334	550	774.56	550	775.49	775.03		1-pixel average
335	551	775.49	551	776.43	775.96		1-pixel average
336	552	776.43	552	777.37	776.90		1-pixel average
337	553	777.37	553	778.30	777.84		1-pixel average
338	554	778.30	554	779.24	778.77		1-pixel average

# Appendix B



## SAGE III Level 1B Solar Transmission Products



**Table B1. Binary File Format Sheet**  
**SAGE III Level 1B Solar Transmission Product**

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
00001	00001	1	I4	0	3	Event Identification Tag (orbit-event code composite number)		
00002	00002	1	I4	4	7	Year-Day Tag (yyyyddd)		
00003	00003	1	R4	8	11	Instrument Elapsed Time in On Station (dddd.frac)		
00004	00004	1	I4	12	15	“Data Fill/Invalid” Value for this Record (Integer Field)		
00005	00005	1	R4	16	19	“Data Fill/Invalid” Value for this Record (Floating Point Field)		
00006	00006	1	I4	20	23	Mission Identification (1 = Meteor-3M)		
00007	00007	1	R4	24	27	Version: Definitive Orbit Processing		
00008	00008	1	R4	28	31	Version: Level 0 Processing		
00009	00009	1	R4	32	35	Version: Director Processing		
00010	00010	1	R4	36	39	Version: Solar Processing		
00011	00011	1	R4	40	43	Version: Spectroscopy		
00012	00012	1	R4	44	47	Version: GRAM 95		
00013	00013	1	R4	48	51	Version: Meteorological		
00014	00014	1	R4	52	55	Transmission Profile Grid Spacing		
00015	00015	1	I4	56	59	Transmission Profile Count		
00016	00016	1	I4	60	63	Number of Ground Track Values		
00017	00017	1	I4	64	67	Meteorological Profile Array Size		
00018	00018	1	I4	68	71	CCD Pixel Group Count		
00019	00019	1	I4	72	75	Altitude-Based Array Size		
00020	00020	1	I4	76	79	Spacecraft-Referenced Event Type (1 = sunrise; 2 = sunset)		
00021	00021	1	I4	80	83	Earth-Referenced Event Type (1 = sunrise; 2 = sunset)		
00022	00022	1	R4	84	87	Event Beta Angle (0.0 ± 61.0)		
00023	00023	1	I4	88	91	Data Capture Start Date (yyyymmdd)		
00024	00024	1	I4	92	95	Data Capture Start Time (hhmmss)		
00025	00025	1	R4	96	99	Subtangent Latitude (0.0 ± 90.0)		
00026	00026	1	R4	100	103	Subtangent Longitude (0.0 ± 180.0)		
00027	00027	1	R4	104	107	Subtangent Altitude		

## Table B1. Continued

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
00028	00028	1	I4	108	111	Data Capture End Date (yyyymmdd)		
00029	00029	1	I4	112	115	Data Capture End Time (hhmmss)		
00030	00030	1	R4	116	119	Subtangent Latitude (0.0 ± 90.0)		
00031	00031	1	R4	120	123	Subtangent Longitude (0.0 ± 180.0)		
00032	00032	1	R4	124	127	Subtangent Altitude	km	
00033	00043	11	I4	128	171	Date (yyyymmdd)		
00044	00054	11	I4	172	215	Time (hhmmss)		
00055	00065	11	R4	216	259	Subtangent Latitude (0.0 ± 90.0)		
00066	00076	11	R4	260	303	Subtangent Longitude (0.0 ± 180.0)		
00077	00087	11	R4	304	347	Ray Path Direction at Subtangent Point (0.0 – 359.99...)		
00088	00088	1	R4	348	351	Tropopause Temperature		
00089	00089	1	R4	352	355	Tropopause Geometric Altitude		
00090	00107	18	R4	356	427	Pressure	hPa	
00108	00125	18	R4	428	499	Temperature	K	
00126	00143	18	R4	500	571	Temperature Uncertainty	K	
00144	00161	18	R4	572	643	Geometric Altitude	km	
00162	00162	1	I4	644	647	Data Source Indicator (1 = DAO*; 2 = NCEP; 3 = None)		
00163	00248	86	I4	648	991	Starting CCD Pixel Number of Pixel Group n		
00249	00334	86	I4	992	1335	Ending CCD Pixel Number of Pixel Group n		
00335	00420	86	R4	1336	1679	Central Wavelength of Pixel Group n		
00421	00506	86	R4	1680	2023	Half-Bandwidth of Pixel Group n	nm	
00507	00706	200	R4	2024	2823	Geometric Altitude		
00707	00906	200	R4	2824	3623	Pressure	hPa	
00907	01106	200	R4	3624	4423	Temperature	K	
01107	01306	200	R4	4424	5223	Temperature Uncertainty	K	
01307	01506	200	I4	5224	6023	Pressure/Temperature Array Source Flags		

\*Data Assimilation Office (DAO): source of research-quality assimilated global data sets (including temperature and geo-potential height).

**Table B1. Continued**

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
01507	01706	200	R4	6024	6823	Pixel Group 0 Transmission Profile (PIN Diode) (Aerosol-Ch 9) <b>Transmission Profiles</b>		
01707	01906	200	R4	6824	7623	Pixel Group 0 Transmission Profile Standard Deviation		
01907	02106	200	I4	7624	8423	Pixel Group 0 Profile Bit Flags (PIN Diode)		
02107	02306	200	R4	8424	9223	Pixel Group 1 Transmission Profile (Mesospheric Ozone)		
02307	02506	200	R4	9224	10023	Pixel Group 1 Transmission Profile Standard Deviation		
02507	02706	200	I4	10024	10823	Pixel Group 1 Profile Bit Flags		
02707	02906	200	R4	10824	11623	Pixel Group 2 Transmission Profile (Aerosol-Ch 1 & Rayleigh)		
02907	03106	200	R4	11624	12423	Pixel Group 2 Transmission Profile Standard Deviation		
03107	03306	200	I4	12424	13223	Pixel Group 2 Profile Bit Flags		
03307	03506	200	R4	13224	14023	Pixel Group 3 Transmission Profile (NO2 Gas)		
03507	03706	200	R4	14024	14823	Pixel Group 3 Transmission Profile Standard Deviation		
03707	03906	200	I4	14824	15623	Pixel Group 3 Profile Bit Flags		
03907	04106	200	R4	15624	16423	Pixel Group 4 Transmission Profile (NO2 Gas)		
04107	04306	200	R4	16424	17223	Pixel Group 4 Transmission Profile Standard Deviation		
04307	04506	200	I4	17224	18023	Pixel Group 4 Profile Bit Flags		
04507	04706	200	R4	18024	18823	Pixel Group 5 Transmission Profile (NO2 Gas)		
04707	04906	200	R4	18824	19623	Pixel Group 5 Transmission Profile Standard Deviation		
04907	05106	200	I4	19624	20423	Pixel Group 5 Profile Bit Flags		
05107	05306	200	R4	20424	21223	Pixel Group 6 Transmission Profile (NO2 Gas)		
05307	05506	200	R4	21224	22023	Pixel Group 6 Transmission Profile Standard Deviation		
05507	05706	200	I4	22024	22823	Pixel Group 6 Profile Bit Flags		
05707	05906	200	R4	22824	23623	Pixel Group 7 Transmission Profile (NO2 Gas)		
05907	06106	200	R4	23624	24423	Pixel Group 7 Transmission Profile Standard Deviation		
06107	06306	200	I4	24424	25223	Pixel Group 7 Profile Bit Flags		
06307	06506	200	R4	25224	26023	Pixel Group 8 Transmission Profile (NO2 Gas)		
06507	06706	200	R4	26024	26823	Pixel Group 8 Transmission Profile Standard Deviation		
06707	06906	200	I4	26824	27623	Pixel Group 8 Profile Bit Flags		
06907	07106	200	R4	27624	28423	Pixel Group 9 Transmission Profile (NO2 Gas)		
07107	07306	200	R4	28424	29223	Pixel Group 9 Transmission Profile Standard Deviation		
07307	07506	200	I4	29224	30023	Pixel Group 9 Profile Bit Flags		

**Table B1. Continued**

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
07507	07706	200	R4	30024	30823	Pixel Group 10 Transmission Profile (NO2 Gas)		
07707	07906	200	R4	30824	31623	Pixel Group 10 Transmission Profile Standard Deviation		
07907	08106	200	I4	31624	32423	Pixel Group 10 Profile Bit Flags		
08107	08306	200	R4	32424	33223	Pixel Group 11 Transmission Profile (NO2 Gas)		
08307	08506	200	R4	33224	34023	Pixel Group 11 Transmission Profile Standard Deviation		
08507	08706	200	I4	34024	34823	Pixel Group 11 Profile Bit Flags		
08707	08906	200	R4	34824	35623	Pixel Group 12 Transmission Profile (NO2 Gas)		
08907	09106	200	R4	35624	36423	Pixel Group 12 Transmission Profile Standard Deviation		
09107	09306	200	I4	36424	37223	Pixel Group 12 Profile Bit Flags		
09307	09506	200	R4	37224	38023	Pixel Group 13 Transmission Profile (NO2 Gas)		
09507	09706	200	R4	38024	38823	Pixel Group 13 Transmission Profile Standard Deviation		
09707	09906	200	I4	38824	39623	Pixel Group 13 Profile Bit Flags		
09907	10106	200	R4	39624	40423	Pixel Group 14 Transmission Profile (NO2 Gas)		
10107	10306	200	R4	40424	41223	Pixel Group 14 Transmission Profile Standard Deviation		
10307	10506	200	I4	41224	42023	Pixel Group 14 Profile Bit Flags		
10507	10706	200	R4	42024	42823	Pixel Group 15 Transmission Profile (NO2 Gas)		
10707	10906	200	R4	42824	43623	Pixel Group 15 Transmission Profile Standard Deviation		
10907	11106	200	I4	43624	44423	Pixel Group 15 Profile Bit Flags		
11107	11306	200	R4	44424	45223	Pixel Group 16 Transmission Profile (NO2 Gas)		
11307	11506	200	R4	45224	46023	Pixel Group 16 Transmission Profile Standard Deviation		
11507	11706	200	I4	46024	46823	Pixel Group 16 Profile Bit Flags		
11707	11906	200	R4	46824	47623	Pixel Group 17 Transmission Profile (NO2 Gas)		
11907	12106	200	R4	47624	48423	Pixel Group 17 Transmission Profile Standard Deviation		
12107	12306	200	I4	48424	49223	Pixel Group 17 Profile Bit Flags		
12307	12506	200	R4	49224	50023	Pixel Group 18 Transmission Profile (Aerosol-Ch2 & NO2 Gas)		
12507	12706	200	R4	50024	50823	Pixel Group 18 Transmission Profile Standard Deviation		
12707	12906	200	I4	50824	51623	Pixel Group 18 Profile Bit Flags		
12907	13106	200	R4	51624	52423	Pixel Group 19 Transmission Profile (Aerosol-Ch2 & NO2 Gas)		
13107	13306	200	R4	52424	53223	Pixel Group 19 Transmission Profile Standard Deviation		
13307	13506	200	I4	53224	54023	Pixel Group 19 Profile Bit Flags		

**Table B1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
13507	13706	200	R4	54024	54823	Pixel Group 20 Transmission Profile (Aerosol-Ch2 & NO2 Gas)		
13707	13906	200	R4	54824	55623	Pixel Group 20 Transmission Profile Standard Deviation		
13907	14106	200	I4	55624	56423	Pixel Group 20 Profile Bit Flags		
14107	14306	200	R4	56424	57223	Pixel Group 21 Transmission Profile (Aerosol-Ch2 & NO2 Gas)		
14307	14506	200	R4	57224	58023	Pixel Group 21 Transmission Profile Standard Deviation		
14507	14706	200	I4	58024	58823	Pixel Group 21 Profile Bit Flags		
14707	14906	200	R4	58824	59623	Pixel Group 22 Transmission Profile (Aerosol-Ch3)		
14907	15106	200	R4	59624	60423	Pixel Group 22 Transmission Profile Standard Deviation		
15107	15306	200	I4	60424	61223	Pixel Group 22 Profile Bit Flags		
15307	15506	200	R4	61224	62023	Pixel Group 23 Not Used (VBP)		
15507	15706	200	R4	62024	62823	Pixel Group 23 Not Used (VBP)		
15707	15906	200	I4	62824	63623	Pixel Group 23 Not Used (VBP)		
15907	16106	200	R4	63624	64423	Pixel Group 24 Not Used (VRP)		
16107	16306	200	R4	64424	65223	Pixel Group 24 Not Used (VRP)		
16307	16506	200	I4	65224	66023	Pixel Group 24 Not Used (VRP)		
16507	16706	200	R4	66024	66823	Pixel Group 25 Transmission Profile (O3 Gas)		
16707	16906	200	R4	66824	67623	Pixel Group 25 Transmission Profile Standard Deviation		
16907	17106	200	I4	67624	68423	Pixel Group 25 Profile Bit Flags		
17107	17306	200	R4	68424	69223	Pixel Group 26 Transmission Profile (O3 Gas)		
17307	17506	200	R4	69224	70023	Pixel Group 26 Transmission Profile Standard Deviation		
17507	17706	200	I4	70024	70823	Pixel Group 26 Profile Bit Flags		
17707	17906	200	R4	70824	71623	Pixel Group 27 Transmission Profile (O3 Gas)		
17907	18106	200	R4	71624	72423	Pixel Group 27 Transmission Profile Standard Deviation		
18107	18306	200	I4	72424	73223	Pixel Group 27 Profile Bit Flags		
18307	18506	200	R4	73224	74023	Pixel Group 28 Transmission Profile (O3 Gas)		
18507	18706	200	R4	74024	74823	Pixel Group 28 Transmission Profile Standard Deviation		
18707	18906	200	I4	74824	75623	Pixel Group 28 Profile Bit Flags		

**Table B1. Continued**

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
18907	19106	200	R4	75624	76423	Pixel Group 29 Transmission Profile (O3 Gas)		
19107	19306	200	R4	76424	77223	Pixel Group 29 Transmission Profile Standard Deviation		
19307	19506	200	I4	77224	78023	Pixel Group 29 Profile Bit Flags		
19507	19706	200	R4	78024	78823	Pixel Group 30 Transmission Profile (O3 Gas)		
19707	19906	200	R4	78824	79623	Pixel Group 30 Transmission Profile Standard Deviation		
19907	20106	200	I4	79624	80423	Pixel Group 30 Profile Bit Flags		
20107	20306	200	R4	80424	81223	Pixel Group 31 Transmission Profile (Aerosol-Ch4 & O3 Gas)		
20307	20506	200	R4	81224	82023	Pixel Group 31 Transmission Profile Standard Deviation		
20507	20706	200	I4	82024	82823	Pixel Group 31 Profile Bit Flags		
20707	20906	200	R4	82824	83623	Pixel Group 32 Transmission Profile (O3 Gas)		
20907	21106	200	R4	83624	84423	Pixel Group 32 Transmission Profile Standard Deviation		
21107	21306	200	I4	84424	85223	Pixel Group 32 Profile Bit Flags		
21307	21506	200	R4	85224	86023	Pixel Group 33 Transmission Profile (O3 Gas)		
21507	21706	200	R4	86024	86823	Pixel Group 33 Transmission Profile Standard Deviation		
21707	21906	200	I4	86824	87623	Pixel Group 33 Profile Bit Flags		
21907	22106	200	R4	87624	88423	Pixel Group 34 Transmission Profile (O3 Gas)		
22107	22306	200	R4	88424	89223	Pixel Group 34 Transmission Profile Standard Deviation		
22307	22506	200	I4	89224	90023	Pixel Group 34 Profile Bit Flags		
22507	22706	200	R4	90024	90823	Pixel Group 35 Transmission Profile (Aerosol-Ch5)		
22707	22906	200	R4	90824	91623	Pixel Group 35 Transmission Profile Standard Deviation		
22907	23106	200	I4	91624	92423	Pixel Group 35 Profile Bit Flags		
23107	23306	200	R4	92424	93223	Pixel Group 36 Transmission Profile (Aerosol-Ch6)		
23307	23506	200	R4	93224	94023	Pixel Group 36 Transmission Profile Standard Deviation		
23507	23706	200	I4	94024	94823	Pixel Group 36 Profile Bit Flags		
23707	23906	200	R4	94824	95623	Pixel Group 37 Transmission Profile (O2 A-Band)		
23907	24106	200	R4	95624	96423	Pixel Group 37 Transmission Profile Standard Deviation		
24107	24306	200	I4	96424	97223	Pixel Group 37 Profile Bit Flags		
24307	24506	200	R4	97224	98023	Pixel Group 38 Transmission Profile (O2 A-Band)		
24507	24706	200	R4	98024	98823	Pixel Group 38 Transmission Profile Standard Deviation		
24707	24906	200	I4	98824	99623	Pixel Group 38 Profile Bit Flags		

**Table B1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
24907	25106	200	R4	99624	100423	Pixel Group 39 Transmission Profile (O2 A-Band)		
25107	25306	200	R4	100424	101223	Pixel Group 39 Transmission Profile Standard Deviation		
25307	25506	200	I4	101224	102023	Pixel Group 39 Profile Bit Flags		
25507	25706	200	R4	102024	102823	Pixel Group 40 Transmission Profile (O2 A-Band)		
25707	25906	200	R4	102824	103623	Pixel Group 40 Transmission Profile Standard Deviation		
25907	26106	200	I4	103624	104423	Pixel Group 40 Profile Bit Flags		
26107	26306	200	R4	104424	105223	Pixel Group 41 Transmission Profile (O2 A-Band)		
26307	26506	200	R4	105224	106023	Pixel Group 41 Transmission Profile Standard Deviation		
26507	26706	200	I4	106024	106823	Pixel Group 41 Profile Bit Flags		
26707	26906	200	R4	106824	107623	Pixel Group 42 Transmission Profile (O2 A-Band)		
26907	27106	200	R4	107624	108423	Pixel Group 42 Transmission Profile Standard Deviation		
27107	27306	200	I4	108424	109223	Pixel Group 42 Profile Bit Flags		
27307	27506	200	R4	109224	110023	Pixel Group 43 Transmission Profile (O2 A-Band)		
27507	27706	200	R4	110024	110823	Pixel Group 43 Transmission Profile Standard Deviation		
27707	27906	200	I4	110824	111623	Pixel Group 43 Profile Bit Flags		
27907	28106	200	R4	111624	112423	Pixel Group 44 Transmission Profile (O2 A-Band)		
28107	28306	200	R4	112424	113223	Pixel Group 44 Transmission Profile Standard Deviation		
28307	28506	200	I4	113224	114023	Pixel Group 44 Profile Bit Flags		
28507	28706	200	R4	114024	114823	Pixel Group 45 Transmission Profile (O2 A-Band)		
28707	28906	200	R4	114824	115623	Pixel Group 45 Transmission Profile Standard Deviation		
28907	29106	200	I4	115624	116423	Pixel Group 45 Profile Bit Flags		
29107	29306	200	R4	116424	117223	Pixel Group 46 Transmission Profile (O2 A-Band)		
29307	29506	200	R4	117224	118023	Pixel Group 46 Transmission Profile Standard Deviation		
29507	29706	200	I4	118024	118823	Pixel Group 46 Profile Bit Flags		
29707	29906	200	R4	118824	119623	Pixel Group 47 Transmission Profile (O2 A-Band)		
29907	30106	200	R4	119624	120423	Pixel Group 47 Transmission Profile Standard Deviation		
30107	30306	200	I4	120424	121223	Pixel Group 47 Profile Bit Flags		

**Table B1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
30307	30506	200	R4	121224	122023	Pixel Group 48 Transmission Profile (O2 A-Band)		
30507	30706	200	R4	122024	122823	Pixel Group 48 Transmission Profile Standard Deviation		
30707	30906	200	I4	122824	123623	Pixel Group 48 Profile Bit Flags		
30907	31106	200	R4	123624	124423	Pixel Group 49 Transmission Profile (O2 A-Band)		
31107	31306	200	R4	124424	125223	Pixel Group 49 Transmission Profile Standard Deviation		
31307	31506	200	I4	125224	126023	Pixel Group 49 Profile Bit Flags		
31507	31706	200	R4	126024	126823	Pixel Group 50 Transmission Profile (O2 A-Band)		
31707	31906	200	R4	126824	127623	Pixel Group 50 Transmission Profile Standard Deviation		
31907	32106	200	I4	127624	128423	Pixel Group 50 Profile Bit Flags		
32107	32306	200	R4	128424	129223	Pixel Group 51 Transmission Profile (Aerosol-Ch7)		
32307	32506	200	R4	129224	130023	Pixel Group 51 Transmission Profile Standard Deviation		
32507	32706	200	I4	130024	130823	Pixel Group 51 Profile Bit Flags		
32707	32906	200	R4	130824	131623	Pixel Group 52 Transmission Profile (Water Vapor)		
32907	33106	200	R4	131624	132423	Pixel Group 52 Transmission Profile Standard Deviation		
33107	33306	200	I4	132424	133223	Pixel Group 52 Profile Bit Flags		
33307	33506	200	R4	133224	134023	Pixel Group 53 Transmission Profile (Water Vapor)		
33507	33706	200	R4	134024	134823	Pixel Group 53 Transmission Profile Standard Deviation		
33707	33906	200	I4	134824	135623	Pixel Group 53 Profile Bit Flags		
33907	34106	200	R4	135624	136423	Pixel Group 54 Transmission Profile (Water Vapor)		
34107	34306	200	R4	136424	137223	Pixel Group 54 Transmission Profile Standard Deviation		
34307	34506	200	I4	137224	138023	Pixel Group 54 Profile Bit Flags		
34507	34706	200	R4	138024	138823	Pixel Group 55 Transmission Profile (Water Vapor)		
34707	34906	200	R4	138824	139623	Pixel Group 55 Transmission Profile Standard Deviation		
34907	35106	200	I4	139624	140423	Pixel Group 55 Profile Bit Flags		
35107	35306	200	R4	140424	141223	Pixel Group 56 Transmission Profile (Water Vapor)		
35307	35506	200	R4	141224	142023	Pixel Group 56 Transmission Profile Standard Deviation		
35507	35706	200	I4	142024	142823	Pixel Group 56 Profile Bit Flags		

**Table B1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
35707	35906	200	R4	142824	143623	Pixel Group 57 Transmission Profile (Water Vapor)		
35907	36106	200	R4	143624	144423	Pixel Group 57 Transmission Profile Standard Deviation		
36107	36306	200	I4	144424	145223	Pixel Group 57 Profile Bit Flags		
36307	36506	200	R4	145224	146023	Pixel Group 58 Transmission Profile (Water Vapor)		
36507	36706	200	R4	146024	146823	Pixel Group 58 Transmission Profile Standard Deviation		
36707	36906	200	I4	146824	147623	Pixel Group 58 Profile Bit Flags		
36907	37106	200	R4	147624	148423	Pixel Group 59 Transmission Profile (Water Vapor)		
37107	37306	200	R4	148424	149223	Pixel Group 59 Transmission Profile Standard Deviation		
37307	37506	200	I4	149224	150023	Pixel Group 59 Profile Bit Flags		
37507	37706	200	R4	150024	150823	Pixel Group 60 Transmission Profile (Water Vapor)		
37707	37906	200	R4	150824	151623	Pixel Group 60 Transmission Profile Standard Deviation		
37907	38106	200	I4	151624	152423	Pixel Group 60 Profile Bit Flags		
38107	38306	200	R4	152424	153223	Pixel Group 61 Transmission Profile (Water Vapor)		
38307	38506	200	R4	153224	154023	Pixel Group 61 Transmission Profile Standard Deviation		
38507	38706	200	I4	154024	154823	Pixel Group 61 Profile Bit Flags		
38707	38906	200	R4	154824	155623	Pixel Group 62 Transmission Profile (Water Vapor)		
38907	39106	200	R4	155624	156423	Pixel Group 62 Transmission Profile Standard Deviation		
39107	39306	200	I4	156424	157223	Pixel Group 62 Profile Bit Flags		
39307	39506	200	R4	157224	158023	Pixel Group 63 Transmission Profile (Water Vapor)		
39507	39706	200	R4	158024	158823	Pixel Group 63 Transmission Profile Standard Deviation		
39707	39906	200	I4	158824	159623	Pixel Group 63 Profile Bit Flags		
39907	40106	200	R4	159624	160423	Pixel Group 64 Transmission Profile (Water Vapor)		
40107	40306	200	R4	160424	161223	Pixel Group 64 Transmission Profile Standard Deviation		
40307	40506	200	I4	161224	162023	Pixel Group 64 Profile Bit Flags		
40507	40706	200	R4	162024	162823	Pixel Group 65 Transmission Profile (Water Vapor)		
40707	40906	200	R4	162824	163623	Pixel Group 65 Transmission Profile Standard Deviation		
40907	41106	200	I4	163624	164423	Pixel Group 65 Profile Bit Flags		

**Table B1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
41107	41306	200	R4	164424	165223	Pixel Group 66 Transmission Profile (Water Vapor)		
41307	41506	200	R4	165224	166023	Pixel Group 66 Transmission Profile Standard Deviation		
41507	41706	200	I4	166024	166823	Pixel Group 66 Profile Bit Flags		
41707	41906	200	R4	166824	167623	Pixel Group 67 Transmission Profile (Water Vapor)		
41907	42106	200	R4	167624	168423	Pixel Group 67 Transmission Profile Standard Deviation		
42107	42306	200	I4	168424	169223	Pixel Group 67 Profile Bit Flags		
42307	42506	200	R4	169224	170023	Pixel Group 68 Transmission Profile (Water Vapor)		
42507	42706	200	R4	170024	170823	Pixel Group 68 Transmission Profile Standard Deviation		
42707	42906	200	I4	170824	171623	Pixel Group 68 Profile Bit Flags		
42907	43106	200	R4	171624	172423	Pixel Group 69 Transmission Profile (Water Vapor)		
43107	43306	200	R4	172424	173223	Pixel Group 69 Transmission Profile Standard Deviation		
43307	43506	200	I4	173224	174023	Pixel Group 69 Profile Bit Flags		
43507	43706	200	R4	174024	174823	Pixel Group 70 Transmission Profile (Water Vapor)		
43707	43906	200	R4	174824	175623	Pixel Group 70 Transmission Profile Standard Deviation		
43907	44106	200	I4	175624	176423	Pixel Group 70 Profile Bit Flags		
44107	44306	200	R4	176424	177223	Pixel Group 71 Transmission Profile (Water Vapor)		
44307	44506	200	R4	177224	178023	Pixel Group 71 Transmission Profile Standard Deviation		
44507	44706	200	I4	178024	178823	Pixel Group 71 Profile Bit Flags		
44707	44906	200	R4	178824	179623	Pixel Group 72 Transmission Profile (Water Vapor)		
44907	45106	200	R4	179624	180423	Pixel Group 72 Transmission Profile Standard Deviation		
45107	45306	200	I4	180424	181223	Pixel Group 72 Profile Bit Flags		
45307	45506	200	R4	181224	182023	Pixel Group 73 Transmission Profile (Water Vapor)		
45507	45706	200	R4	182024	182823	Pixel Group 73 Transmission Profile Standard Deviation		
45707	45906	200	I4	182824	183623	Pixel Group 73 Profile Bit Flags		
45907	46106	200	R4	183624	184423	Pixel Group 74 Transmission Profile (Water Vapor)		
46107	46306	200	R4	184424	185223	Pixel Group 74 Transmission Profile Standard Deviation		
46307	46506	200	I4	185224	186023	Pixel Group 74 Profile Bit Flags		
46507	46706	200	R4	186024	186823	Pixel Group 75 Transmission Profile (Water Vapor)		
46707	46906	200	R4	186824	187623	Pixel Group 75 Transmission Profile Standard Deviation		
46907	47106	200	I4	187624	188423	Pixel Group 75 Profile Bit Flags		

**Table B1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
47107	47306	200	R4	188424	189223	Pixel Group 76 Transmission Profile (Water Vapor)		
47307	47506	200	R4	189224	190023	Pixel Group 76 Transmission Profile Standard Deviation		
47507	47706	200	I4	190024	190823	Pixel Group 76 Profile Bit Flags		
47707	47906	200	R4	190824	191623	Pixel Group 77 Transmission Profile (Water Vapor)		
47907	48106	200	R4	191624	192423	Pixel Group 77 Transmission Profile Standard Deviation		
48107	48306	200	I4	192424	193223	Pixel Group 77 Profile Bit Flags		
48307	48506	200	R4	193224	194023	Pixel Group 78 Transmission Profile (Water Vapor)		
48507	48706	200	R4	194024	194823	Pixel Group 78 Transmission Profile Standard Deviation		
48707	48906	200	I4	194824	195623	Pixel Group 78 Profile Bit Flags		
48907	49106	200	R4	195624	196423	Pixel Group 79 Transmission Profile (Water Vapor)		
49107	49306	200	R4	196424	197223	Pixel Group 79 Transmission Profile Standard Deviation		
49307	49506	200	I4	197224	198023	Pixel Group 79 Profile Bit Flags		
49507	49706	200	R4	198024	198823	Pixel Group 80 Transmission Profile (Water Vapor)		
49707	49906	200	R4	198824	199623	Pixel Group 80 Transmission Profile Standard Deviation		
49907	50106	200	I4	199624	200423	Pixel Group 80 Profile Bit Flags		
50107	50306	200	R4	200424	201223	Pixel Group 81 Transmission Profile (Aerosol-Ch8)		
50307	50506	200	R4	201224	202023	Pixel Group 81 Transmission Profile Standard Deviation		
50507	50706	200	I4	202024	202823	Pixel Group 81 Profile Bit Flags		
50707	50906	200	R4	202824	203623	Pixel Group 82 Transmission Profile (Aerosol-Ch8)		
50907	51106	200	R4	203624	204423	Pixel Group 82 Transmission Profile Standard Deviation		
51107	51306	200	I4	204424	205223	Pixel Group 82 Profile Bit Flags		
51307	51506	200	R4	205224	206023	Pixel Group 83 Transmission Profile (Aerosol-Ch8)		
51507	51706	200	R4	206024	206823	Pixel Group 83 Transmission Profile Standard Deviation		
51707	51906	200	I4	206824	207623	Pixel Group 83 Profile Bit Flags		
51907	52106	200	R4	207624	208423	Pixel Group 84 Transmission Profile (Aerosol-Ch8)		
52107	52306	200	R4	208424	209223	Pixel Group 84 Transmission Profile Standard Deviation		
52307	52506	200	I4	209224	210023	Pixel Group 84 Profile Bit Flags		

**Table B1. Concluded**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
52507	52706	200	R4	210024	210823	Pixel Group 85 Transmission Profile (Aerosol-Ch8)		
52707	52906	200	R4	210824	211623	Pixel Group 85 Transmission Profile Standard Deviation		
52907	53106	200	I4	211624	212423	Pixel Group 85 Profile Bit Flags		
53107	53306	200	R4	212424	213223	Pixel Group 86 Transmission Profile (Aerosol-Ch8)		
53307	53506	200	R4	213224	214023	Pixel Group 86 Transmission Profile Standard Deviation		
53507	53706	200	I4	214024	214823	Pixel Group 86 Profile Bit Flags		

**Table B2. HDF File Format Sheet**  
**SAGE III Level 1B Solar Transmission Product**

Vgroup/Vdata	Field Name	Num. Value	Data Type	Units
Section 1.0-File Header/Section 1.0-File Header	Event Identification Tag (orbit-event code composite number) Year-Day Tag (yyyyddd) Instrument Elapsed Time On Stations (ETOS) (dddd.frac) Integer Data Fill/Invalid Real Data Fill/Invalid Mission Identification (1 = Meteor-3M)	1 1 1 1 1 1	Int32 Int32 Real32 Int32 Real32 Int32	
Section 2.0-Product Identification/Section 2.0-Product Identification	Definitive Orbit Version # Level 0 Version # Database Version # GRAM 95 Version # Meteorological Version# Director Processing Version # Solar Processing Version #	1 1 1 1 1 1 1	Real32 Real32 Real32 Real32 Real32 Real32 Real32	
Section 3.0-File Description/Section 3.0-File Description	Transmission Profile Grid Spacing Transmission Profile Count Number of Ground Track Values Meteorological Profile Array Size CCD Pixel Group Count Altitude-based Array Size	1 1 1 1 1 1	Real32 Int32 Int32 Int32 Int32 Int32	km
Section 4.0-Event Identification/Section 4.0-Event Identification	Spacecraft-referenced Event Type Earth-referenced Event Type Event Beta Angle	1 1 1	Int32 Int32 Real32	deg
Section 4.1-Science Data Start Info/Section 4.1-Science Data Start Info	Data Capture Start Date (yyyymmdd) Data Capture Start Time (hhmmss) Data Capture Start Subtangent Latitude (0.0 ± 90.0) Data Capture Start Subtangent Longitude (0.0 ± 180.0) Data Capture Start Subtangent Altitude	1 1 1 1 1	Int32 Int32 Real32 Real32 Real32	deg deg km

**Table B2. Continued**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Section 4.2-Science Data End Info./Section 4.2-Science Data End Info.	Data Capture End Date (yyyymmdd)	1	Real32	
	Data Capture End Time (hhmmss)	1	Real32	
	Data Capture End Subtangent Latitude (0.0 ± 90.0)	1	Real32	deg
	Data Capture End Subtangent Longitude (0.0 ± 180.0)	1	Real32	deg
	Data Capture End Subtangent Altitude	1	Real32	km
	Date (yyyymmdd)	11	Int32	
	Time (hhmmss)	11	Int32	
	Subtangent Latitude (0.0 ± 90.0)	11	Real32	deg
	Subtangent Longitude (0.0 ± 180.0)	11	Real32	deg
	Ray Path Direction @ Subtangent Point	11	Real32	deg
	Tropopause Temperature	1	Real32	K
	Tropopause Geometric Altitude	1	Real32	km
	Data Source Indicator (1 = DAO*; 2 = NCEP; 3 = None)	1	Int32	
	Pressure			
	Temperature	18	Real32	hPa
	Temperature Uncertainty	18	Real32	K
	Geometric Altitude	18	Real32	K
	18	Real32	km	
	Starting CCD Pixel Number			
	Ending CCD Pixel Number	86	Int32	
	Central Wavelength Pixel Group n	86	Int32	
	Half-Bandwidth of Pixel Group n	86	Real32	nm
	86	Real32	nm	
	Geometric Altitude			
	Pressure	200	Real32	km
		200	Real32	hPa

\*Data Assimilation Office (DAO): source of research-quality assimilated global data sets (including temperature and geo-potential height).

**Table B2. Concluded**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Section 4.2-Science Data End Info./Section 4.2-Science Data End Info. (continued)	Temperature	200	Real32	K
	Temperature Uncertainty	200	Real32	K
	Temperature/Pressure Array Source Flag	200	Int32	
	Transmission Profile	200 x 87	Real32	
	Transmission Profile Standard Deviation	200 x 87	Real32	
	Transmission Profile QA Bit Flags	200 x 87	Int32	

# Appendix C

## SAGE III Level 2 Solar Species Products

# Table C1. Binary File Format Sheet

## Sage III Level 2 Solar Species Product

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
0001	0001	1	I4	0	3	Event Identification Tag (orbit-event code composite number)	<b>File Header</b>	
0002	0002	1	I4	4	7	Year-Day Tag (yyyyddd)		
0003	0003	1	R4	8	11	Instrument Elapsed Time in Orbit (dddd.frac)		
0004	0004	1	I4	12	15	"Data Fill/Invalid" Value for this Record (Integer Field)		
0005	0005	1	R4	16	19	"Data Fill/Invalid" Value for this Record (Floating Point Field)		
0006	0006	1	I4	20	23	Mission Identification (1 = Meteor-3M)		
0007	0007	1	R4	24	27	Version: Definitive Orbit Processing	<b>Version Tracking</b>	
0008	0008	1	R4	28	31	Version: Level 0 Processing		
0009	0009	1	R4	32	35	Version: Director Processing		
0010	0010	1	R4	36	39	Version: Solar Processing		
0011	0011	1	R4	40	43	Version: Spectroscopy		
0012	0012	1	R4	44	47	Version: GRAM 95		
0013	0013	1	R4	48	51	Version: Meteorological		
0014	0014	1	R4	52	55	Altitude-Based Grid Spacing	<b>File Description</b>	km
0015	0015	1	I4	56	59	Number of Altitude-Based Array Values		
0016	0016	1	I4	60	63	Number of Aerosol Channels		
0017	0017	1	I4	64	67	Number of Ground Track Values		
0018	0018	1	I4	68	71	Number of Aerosol Extinction Altitude Levels		
0019	0019	1	I4	72	75	Spacecraft-Referenced Event Type (1 - sunrise; 2 = sunset)	<b>Event Type</b>	deg
0020	0020	1	I4	76	79	Earth-Referenced Event Type (1 - sunrise; 2 = sunset)		
0021	0021	1	R4	80	83	Event Beta Angle (0.0 ± 61.0)		
0022	0022	1	I4	84	87	Data Capture Start Date (yyyymmdd)	<b>Data Capture Start Information</b>	deg
0023	0023	1	I4	88	91	Data Capture Start Time (hhmmss)		
0024	0024	1	R4	92	95	Subtangent Latitude (0.0 ± 90.0)		
0025	0025	1	R4	96	99	Subtangent Longitude (0.0 ± 180.0)		
0026	0026	1	R4	100	103	Subtangent Altitude		

**Table C1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
0027	0027	1	I4	104	107	Data Capture End Date (yyyymmdd)		
0028	0028	1	I4	108	111	Data Capture End Time (hhmmss)		
0029	0029	1	R4	112	115	Subtangent Latitude ( $0.0 \pm 90.0$ )		
0030	0030	1	R4	116	119	Subtangent Longitude ( $0.0 \pm 180.0$ )		
0031	0031	1	R4	120	123	Subtangent Altitude	deg deg km	
0032	0042	11	I4	124	167	Date (yyyymmdd)		
0043	0053	11	I4	168	211	Time (hhmmss)		
0054	0064	11	R4	212	255	Subtangent Latitude ( $0.0 \pm 90.0$ )	deg	
0065	0075	11	R4	256	299	Subtangent Longitude ( $0.0 \pm 180.0$ )	deg	
0076	0086	11	R4	300	343	Ray Path Direction at Subtangent Point (0.0 to 359.9999...)	deg	
0087	0286	200	I4	344	1143	Homogeneity Flags		
0287	0486	200	R4	1144	1943	Geometric Altitude	km	
0487	0686	200	R4	1944	2743	Geopotential Altitude	km	
0687	0886	200	R4	2744	3543	Temperature		
0887	1086	200	R4	3544	4343	Temperature Uncertainty	K	
1087	1286	200	R4	4344	5143	Pressure	K	
1287	1486	200	R4	5144	5943	Pressure Uncertainty	hPa	
1487	1686	200	I4	5944	6743	Pressure/Temperature Array Source Flags (0=Retrieved, 1=GRAM95, 2=NCEP, 3=DAO*, 4=Source Transition Value)	hPa	
1687	1687	1	R4	6744	6747	Tropopause Temperature		
1688	1688	1	R4	6748	6751	Tropopause Geometric Altitude	K km	
1689	1888	200	R4	6752	7551	Ozone Concentration		
1889	2088	200	R4	7552	8351	Ozone Concentration Uncertainty	cm <sup>-3</sup>	
2089	2288	200	R4	8352	9151	Ozone Slant Path Column Density	cm <sup>-2</sup>	
2289	2488	200	R4	9152	9951	Ozone Slant Path Column Density Uncertainty	cm <sup>-2</sup>	
2489	2688	200	I4	9952	10751	Composite Ozone QA Bit Flags	cm <sup>-2</sup>	

\*Data Assimilation Office (DAO): source of research-quality assimilated global data sets (including temperature and geo-potential height).

**Table C1. Continued**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
2689	2888	200	R4	10752	11551	Ozone Concentration	<b>Mesospheric Ozone</b>	$\text{cm}^{-3}$
2889	3088	200	R4	11552	12351	Ozone Concentration Uncertainty		
3089	3288	200	R4	12352	13151	Ozone Slant Path Column Density		
3289	3488	200	R4	13152	13951	Ozone Slant Path Column Density Uncertainty		
3489	3688	200	I4	13952	14751	Mesospheric Ozone QA Bit Flags		
3689	3888	200	R4	14752	15551	Ozone Concentration	<b>MLR Ozone</b>	$\text{cm}^{-3}$
3889	4088	200	R4	15552	16351	Ozone Concentration Uncertainty		
4089	4288	200	R4	16352	17151	Ozone Slant Path Column Density		
4289	4488	200	R4	17152	17951	Ozone Slant Path Column Density Uncertainty		
4489	4688	200	I4	17952	18751	MLR Ozone QA Bit Flags		
4689	4888	200	R4	18752	19551	Ozone Concentration	<b>Ozone-Least Squares</b>	$\text{cm}^{-3}$
4889	5088	200	R4	19552	20351	Ozone Concentration Uncertainty		
5089	5288	200	R4	20352	21151	Ozone Slant Path Column Density		
5289	5488	200	R4	21152	21951	Ozone Slant Path Column Density Uncertainty		
5489	5688	200	I4	21952	22751	Ozone Least Squares QA Bit Flags		
5689	5888	200	R4	22752	23551	Water Vapor Concentration	<b>Water Vapor</b>	$\text{cm}^{-3}$
5889	6088	200	R4	23552	24351	Water Vapor Concentration Uncertainty		
6089	6288	200	I4	24352	25151	Water Vapor QA Bit Flags		
6289	6488	200	R4	25152	25951	Nitrogen Dioxide Concentration	<b>NO<sub>2</sub></b>	$\text{cm}^{-3}$
6489	6688	200	R4	25952	26751	Nitrogen Dioxide Concentration Uncertainty		
6689	6888	200	R4	26752	27551	Nitrogen Dioxide Slant Path Column Density		
6889	7088	200	R4	27552	28351	Nitrogen Dioxide Slant Path Column Density Uncertainty		
7089	7288	200	I4	28352	29151	Nitrogen Dioxide QA Bit Flags		
7289	7488	200	R4	29152	29951	Temperature	<b>Retrieved T/P</b>	K K hPa hPa
7489	7688	200	R4	29952	30751	Temperature Uncertainty		
7689	7888	200	R4	30752	31551	Pressure		
7889	8088	200	R4	31552	32351	Pressure Uncertainty		
8089	8288	200	I4	32352	33151	Pressure/Temperature QA Bit Flags		
8289	8297	9	R4	33152	33187	Centerline Wavelengths of Aerosol Channels	<b>Aerosol Information</b>	nm nm
8298	8306	9	R4	33188	33223	Half-Bandwidths of Aerosol Channels		
8307	8315	9	R4	33224	33259	Stratospheric Optical Depth		
8316	8324	9	R4	33260	33295	Stratospheric Optical Depth Uncertainty		
8325	8333	9	I4	33296	33331	Stratospheric Optical Depth QA Bit Flags		

## Table C1. Concluded

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
7334	7423	90	R4	33332	33691	Aerosol Extinction Channel 1	<b>Aerosol Extinction 385 nm</b>	$\text{km}^{-1}$
7424	7513	90	R4	33692	34051	Aerosol Extinction Uncertainty Channel 1		$\text{km}^{-1}$
7514	7603	90	I4	64052	34411	Aerosol Extinction QA Bit Flags Channel 1		
7604	7693	90	R4	34412	34771	Aerosol Extinction Channel 2	<b>Aerosol Extinction 449 nm</b>	$\text{km}^{-1}$
7694	7783	90	R4	34772	35131	Aerosol Extinction Uncertainty Channel 2		$\text{km}^{-1}$
7784	7873	90	I4	35132	35491	Aerosol Extinction QA Bit Flags Channel 2		
7874	7963	90	R4	35492	35851	Aerosol Extinction Channel 3	<b>Aerosol Extinction 521 nm</b>	$\text{km}^{-1}$
7964	8053	90	R4	35852	36211	Aerosol Extinction Uncertainty Channel 3		$\text{km}^{-1}$
8054	8143	90	I4	36212	36571	Aerosol Extinction QA Bit Flags Channel 3		
8144	8233	90	R4	36572	36931	Aerosol Extinction Channel 4	<b>Aerosol Extinction 602 nm</b>	$\text{km}^{-1}$
8234	8323	90	R4	36932	37291	Aerosol Extinction Uncertainty Channel 4		$\text{km}^{-1}$
8324	8413	90	I4	37292	37651	Aerosol Extinction QA Bit Flags Channel 4		
8414	8503	90	R4	37652	38011	Aerosol Extinction Channel 5	<b>Aerosol Extinction 676 nm</b>	$\text{km}^{-1}$
8504	8593	90	R4	38012	38371	Aerosol Extinction Uncertainty Channel 5		$\text{km}^{-1}$
8594	8683	90	I4	38372	38731	Aerosol Extinction QA Bit Flags Channel 5		
8684	8773	90	R4	38732	39091	Aerosol Extinction Channel 6	<b>Aerosol Extinction 756 nm</b>	$\text{km}^{-1}$
8774	8863	90	R4	39092	69451	Aerosol Extinction Uncertainty Channel 6		$\text{km}^{-1}$
8864	8953	90	I4	69452	69811	Aerosol Extinction QA Bit Flags Channel 6		
8954	9043	90	R4	39812	40171	Aerosol Extinction Channel 7	<b>Aerosol Extinction 869 nm</b>	$\text{km}^{-1}$
9044	9133	90	R4	40172	39361	Aerosol Extinction Uncertainty Channel 7		$\text{km}^{-1}$
9134	9223	90	I4	40532	40891	Aerosol Extinction QA Bit Flags Channel 7		
9224	9313	90	R4	40892	41251	Aerosol Extinction Channel 8	<b>Aerosol Extinction 1020 nm</b>	$\text{km}^{-1}$
9314	9403	90	R4	41252	41611	Aerosol Extinction Uncertainty Channel 8		$\text{km}^{-1}$
9404	9493	90	I4	41612	41971	Aerosol Extinction QA Bit Flags Channel 8		
9494	9583	90	R4	41972	42331	Aerosol Extinction Channel 9	<b>Aerosol Extinction 1550 nm</b>	$\text{km}^{-1}$
9584	9673	90	R4	42332	42691	Aerosol Extinction Uncertainty Channel 9		$\text{km}^{-1}$
9674	9763	90	I4	42692	43051	Aerosol Extinction QA Bit Flags Channel 9		
9764	9853	90	I4	43052	43411	Aerosol Spectral Dependence Flag	<b>Aerosol Extinction Ratio</b>	
9854	9943	90	R4	43412	43771	1020nm/Rayleigh Extinction Ratio		
9944	10033	90	R4	43772	44131	1020nm/Rayleigh Extinction Ratio Uncertainty		
10034	10123	90	I4	44132	44491	1020nm/Rayleigh Extinction Ratio QA Bit Flags		

## Table C2. HDF File Format Sheet Sage III Level 2 Solar Species Product

Vgroup/Vdata	Field Name	Num. Value	Data Type	Units
Section 1.0-File Header/File Header	Event Identification Tag (orbit-event code composite number) Year-Day Tag (yyyyddd) Instrument ETOS (dddd.frac) Integer Data Fill/Invalid Real Data Fill/Invalid Mission Id (1 = Meteor-3M)	1 1 1 1 1 1	Int32 Int32 Real32 Int32 Real32 Int32	
Section 2.0=Product Identification/Product Identification	Definitive Orbit Version # Level 0 Version # Database Version # GRAM 95 Version # Meteorological Version# Director Processing Version # Solar Processing Version #	1 1 1 1 1 1 1	Real32 Real32 Real32 Real32 Real32 Real32 Real32	
Section 3.0-File Description/File Description	Altitude-based Grid Spacing Number of altitude-based array values Number of aerosol channels Number of Ground Track Values # of Aerosol Extinction Altitude Levels	1 1 1 1 1	Real32 Int32 Int32 Int32 Int32	km
Section 4.0-Event Identification/Event Identification	Spacecraft-referenced Event Type Earth-referenced Event Type Event Beta Angle	1 1 1	Int32 Int32 Real32	deg
Section 4.1-Data Capture Start Info./Data Capture Start Info.	Data Capture Start Date (yyyymmdd) Data Capture Start Time (hhmmss) Data Capture Start Subtangent Latitude (0.0 ± 90.0) Data Capture Start Subtangent Longitude (0.0 ± 180.0) Data Capture Start Subtangent Altitude	1 1 1 1 1	Int32 Int32 Real32 Real32 Real32	deg deg km

**Table C2. Continued**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Section 4.2-Data Capture End Info./Data Capture End Info.	Data Capture End Date (yyyymmdd) Data Capture End Time (hhmmss) Data Capture End Subtangent Latitude (0.0 ± 90.0) Data Capture End Subtangent Longitude (0.0 ± 180.0) Data Capture End Subtangent Altitude	1 1 1 1 1	Int32 Int32 Real32 Real32 Real32	deg deg km
Section 4.3-Ground Track Data/Ground Track Data	Date (yyyymmdd) Time (hhmmss) Subtangent Latitude (0.0 ± 90.0) Subtangent Longitude (0.0 ± 180.0) Ray Path Direction @ Subtangent Point	11 11 11 11 11	Int32 Int32 Real32 Real32 Real32	deg deg deg
Section 5.0-Altitude-based Data/Altitude-based Data	Homogeneity Flags Geometric Altitude Geopotential Altitude	200 200 200	Int32 Real32 Real32	km km
Section 5.1-Temp./press. Profiles/Temp./press. Profiles	Temperature Temperature Uncertainty Pressure Pressure Uncertainty PT Array Source Flags	200 200 200 200 200	Real32 Real32 Real32 Real32 Int32	K K hPa hPa
Section 5.1A-Derived Trop. Data/Derived Trop. Data	Tropopause Temperature Tropopause Geometric Altitude	1 1	Real32 Real32	K km
Section 5.2-Composite Ozone Profiles/Ozone Profiles	Ozone Concentration Ozone Concentration Uncertainty Ozone Slant Path Column Density Ozone Slant Path Column Density Uncertainty Ozone QA Bit Flags	200 200 200 200 200	Real32 Real32 Real32 Real32 Int32	cm <sup>-3</sup> cm <sup>-3</sup> cm <sup>-2</sup> cm <sup>-2</sup>

**Table C2. Continued**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Section 5.2A-Mesospheric Ozone Profiles/Ozone Profiles	Ozone Concentration	200	Real32	cm <sup>-3</sup>
	Ozone Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Ozone Slant Path Column Density	200	Real32	cm <sup>-2</sup>
	Ozone Slant Path Column Density Uncertainty	200	Real32	cm <sup>-2</sup>
	Ozone QA Bit Flags	200	Int32	
Section 5.2-B-MLR Ozone Profiles/Ozone Profiles	Ozone Concentration	200	Real32	cm <sup>-3</sup>
	Ozone Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Ozone Slant Path Column Density	200	Real32	cm <sup>-2</sup>
	Ozone Slant Path Column Density Uncertainty	200	Real32	cm <sup>-2</sup>
	Ozone QA Bit Flags	200	Int32	
Section 5.3-Ozone Least Squares Profiles/Ozone Profiles	Ozone Concentration	200	Real32	cm <sup>-3</sup>
	Ozone Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Ozone Slant Path Column Density	200	Real32	cm <sup>-2</sup>
	Ozone Slant Path Column Density Uncertainty	200	Real32	cm <sup>-2</sup>
	Ozone QA Bit Flags	200	Int32	
Section 5.4-Water Vapor Profiles/Water Vapor Profiles	Water Vapor Concentration	200	Real32	cm <sup>-3</sup>
	Water Vapor Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Water Vapor	200	Int32	
Section 5.5-Nitrogen Dioxide Profiles/Nitrogen Dioxide Profiles	Nitrogen Dioxide Concentration	200	Real32	cm <sup>-3</sup>
	Nitrogen Dioxide Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Nitrogen Dioxide SP Column Density	200	Real32	cm <sup>-2</sup>
	Nitrogen Dioxide SP Column Density Uncertainty	200	Real32	cm <sup>-2</sup>
	Nitrogen Dioxide QA bit flags	200	Int32	
Section 5.6-Retrieved T/P Profiles/Retrieved T/P Profiles	Temperature	200	Real32	K
	Temperature Uncertainty	200	Real32	K
	Pressure	200	Real32	hPa
	Pressure Uncertainty	200	Real32	hPa
	Pressure/Temperature QA bit flags	200	Int32	

**Table C2. Continued**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Section 6.0-Aerosol Information/Aerosol Information	Aerosol Channels Centerline Wavelengths	9	Real32	nm
	Aerosol Channels Half-Bandwidths	9	Real32	nm
	Stratospheric Optical Depth	9	Real32	
	Stratospheric Optical Depth Uncertainty	9	Real32	
	Stratospheric Optical Depth QA bit flags	9	Int32	
Section 6.1-Aerosol Extinction Profiles/Aerosol Extinction Profiles	Aerosol Extinction Channel 1	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 1	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 1	90	Int32	
	Aerosol Extinction Channel 2	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 2	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 2	90	Int32	
	Aerosol Extinction Channel 3	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 3	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 3	90	Int32	
	Aerosol Extinction Channel 4	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 4	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 4	90	Int32	
	Aerosol Extinction Channel 5	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 5	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 5	90	Int32	
	Aerosol Extinction Channel 6	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 6	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 6	90	Int32	
	Aerosol Extinction Channel 7	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 7	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 7	90	Int32	

## Table C2. Concluded

Vgroup/Vdata	Field Name	Num. Value	Data Type	Units
Section 6.2-Aerosol Extinction Ratio Profile/Aerosol Extinction Ratio Profile	Aerosol Extinction Channel 8	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 8	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 8	90	Int32	
	Aerosol Extinction Channel 9	90	Real32	km <sup>-1</sup>
	Aerosol Extinction Uncertainty Channel 9	90	Real32	km <sup>-1</sup>
	Aerosol Extinction QA bit flags Channel 9	90	Int32	
	1020nm/Rayleigh Extinction Ratio	90	Real32	
	1020nm/Rayleigh Extinction Ratio Uncertainty	90	Real32	
	1020nm/Rayleigh Extinction Ratio QA bit flags	90	Int32	
	Aerosol Spectral Dependence Flag	90	Int32	

# Appendix D

## SAGE III Level 2 Lunar Species Products

**Table D1. Binary File Format Sheet  
SAGE III Level 2 Lunar Species Product**

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
0001	0001	1	I4	0	3	Event Identification Tag (orbit-event code composite number)	<b>File Header</b>	
0002	0002	1	I4	4	7	Year-Day Tag (yyyyddd)		
0003	0003	1	R4	8	11	Instrument Elapsed Time in On Station (dddd.frac)		
0004	0004	1	I4	12	15	“Data Fill/Invalid” Value for this Record (Integer Field)		
0005	0005	1	R4	16	19	“Data Fill/Invalid” Value for this Record (Floating Point Field)		
0006	0006	1	I4	20	23	Mission Identification (1 = Meteor-3M)		
0007	0007	1	R4	24	27	Version: Definitive Orbit Processing	<b>Version Tracking</b>	
0008	0008	1	R4	28	31	Version: Level 0 Processing		
0009	0009	1	R4	32	35	Version: Director Processing		
0010	0010	1	R4	36	39	Version: Solar Processing		
0011	0011	1	R4	40	43	Version: Spectroscopy		
0012	0012	1	R4	44	47	Version: GRAM 95		
0013	0013	1	R4	48	51	Version: Meteorological		
0014	0014	1	R4	52	55	Version: Lunar Model		
0015	0015	1	R4	56	59	Version: Lunar Albedo		
0016	0016	1	R4	60	63	Altitude-Based Grid Spacing	<b>File Description</b>	<b>0.5 200 18 11</b>
0017	0017	1	I4	64	67	Number of Altitude-Based Array Values		
0018	0018	1	I4	68	71	Meteorological Profile Array Size		
0019	0019	1	I4	72	75	Number of Ground Track Values		
0020	0020	1	I4	76	79	Spacecraft-Referenced Event Type (3 = moonrise; 4 = moonset)	<b>Event Type</b>	
0021	0021	1	I4	80	83	Earth-Referenced Event Type (3 = moonrise; 4 = moonset)		
0022	0022	1	R4	84	87	Event Beta Angle (0.0 ± 61.0)		
0023	0023	1	R4	88	91	Lunar Phase (0.0 = new moon; 1.0 = full moon)		
0024	0024	1	R4	92	95	Solar Zenith Angle		
0025	0025	1	I4	96	99	Aurora Contamination Flag (0 = not checked; 1 = not detected; 2 = detected)		
0026	0026	1	I4	100	103	Data Capture Start Date (yyyymmdd)	<b>Data Capture Start Information</b>	
0027	0027	1	I4	104	107	Data Capture Start Time (hhmmss)		
0028	0028	1	R4	108	111	Subtangent Latitude (0.0 ± 90.0)		
0029	0029	1	R4	112	115	Subtangent Longitude (0.0 ± 180.0)		
0030	0030	1	R4	116	119	Subtangent Altitude		

**Table D1. Continued**

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
0031	0031	1	I4	120	123	Data Capture End Date (yyyymmdd)		
0032	0032	1	I4	124	127	Data Capture End Time (hhmmss)		
0033	0033	1	R4	128	131	Subtangent Latitude (0.0 ± 90.0)		
0034	0034	1	R4	132	135	Subtangent Longitude (0.0 ± 180.0)		
0035	0035	1	R4	136	139	Subtangent Altitude	km	
0036	0046	11	I4	140	183	Date (yyyymmdd)		
0047	0057	11	I4	184	227	Time (hhmmss)		
0058	0068	11	R4	228	271	Subtangent Latitude (0.0 ± 90.0)	deg	
0069	0079	11	R4	272	315	Subtangent Longitude (0.0 ± 180.0)	deg	
0080	0090	11	R4	316	359	Ray Path Direction at Subtangent Point (0.0 to 359.9999...)	deg	
0091	0091	1	R4	360	363	Tropopause Temperature		
0092	0092	1	R4	364	367	Tropopause Altitude		
0093	0110	18	R4	368	439	Pressure		
0111	0128	18	R4	440	511	Temperature	hPa	
0129	0146	18	R4	512	583	Temperature Uncertainty	K	
0147	0164	18	R4	584	655	Geometric Altitude	K	
0165	0165	1	I4	656	659	Data Source Indicator (1 = DAO; 2 = NCEP; 3 = Not Available)	km	
0166	0365	200	R4	660	1459	Geometric Altitude		
0366	0565	200	I4	1460	2259	Altitude Registration QA Flags	km	
0566	0765	200	R4	2260	3059	Geopotential Altitude	km	
0766	0965	200	R4	3060	3859	Temperature Profile (Altitude-based)		
0966	1165	200	R4	3860	4659	Temperature Uncertainty	K	
1166	1365	200	R4	4660	5459	Pressure	K	
1366	1565	200	R4	5460	6259	Pressure Uncertainty	hPa	
1566	1765	200	I4	6260	7059	Pressure/Temperature Array Source Flag (1=GRAM95, 2=NCEP 3=DAO*, 4=Source Transition Value)	hPa	

\*Data Assimilation Office (DAO): source of research-quality assimilated global data sets (including temperature and geo-potential height).

**Table D1. Concluded**

<b>Field Num. Start</b>	<b>Field Num. End</b>	<b>Num. Values</b>	<b>F90 Type</b>	<b>Start Byte</b>	<b>End Byte</b>	<b>Description</b>	<b>Eng. Units</b>	<b>Note</b>
1766	1965	200	R4	7060	7859	Ozone Concentration	Ozone	$\text{cm}^{-3}$
1966	2165	200	R4	7860	8659	Ozone Concentration Uncertainty		$\text{cm}^{-3}$
2166	2365	200	I4	8660	9459	Ozone QA Bit Flags		
2366	2565	200	R4	9460	10259	Nitrogen Dioxide Concentration	$\text{NO}_2$	$\text{cm}^{-3}$
2566	2765	200	R4	10260	11059	Nitrogen Dioxide Concentration Uncertainty		$\text{cm}^{-3}$
2766	2965	200	I4	11060	11859	Nitrogen Dioxide QA Bit Flags		
2966	3165	200	R4	11860	12659	Nitrogen Trioxide Concentration	$\text{NO}_3$	$\text{cm}^{-3}$
3166	3365	200	R4	12660	13459	Nitrogen Trioxide Concentration Uncertainty		$\text{cm}^{-3}$
3366	3565	200	I4	13460	14259	Nitrogen Trioxide QA Bit Flags		
3566	3765	200	R4	14260	15059	OCIO Concentration	$\text{OCIO}$	$\text{cm}^{-3}$
3766	3965	200	R4	15060	15859	OCIO Concentration Uncertainty		$\text{cm}^{-3}$
3966	4165	200	I4	15860	16659	OCIO QA Bit Flags		

**Table D2. HDF File Format Sheet**  
**SAGE III Level 2 Lunar Species Product**

Vgroup/Vdata	Field Name	Num. Value	Data Type	Units
Section 1.0-File Header/File Header	Event Identification Tag (orbit-event code composite number) Year-Day Tag (yyyyddd) Instrument ETOS (dddd.frac) Integer Data Fill/Invalid Real Data Fill/Invalid Mission Id (1 = Meteor-3M)	1 1 1 1 1 1	Int32 Int32 Real32 Int32 Real32 Int32	
Section 2.0-Product Identification/Product Identification	Definitive Orbit Version # Level 0 Version # Database Version # GRAM 95 Version # Meteorological Version # Director Processing Version # Solar Processing Version #	1 1 1 1 1 1 1	Real32 Real32 Real32 Real32 Real32 Real32 Real32	
Section 3.0-File Description/File Description	Altitude-based Grid Spacing Number of altitude-based array values Number of Ground Track Values Number of Retrieved Temperature/Pressure Levels	1 1 1 1	Real32 Int32 Int32 Int32	km
Section 4.0-Event Identification/Event Identification	Spacecraft-referenced Event Type Earth-referenced Event Type Event Beta Angle Lunar Phase Solar Zenith Angle Aurora Contamination Flag	1 1 1 1 1 1	Int32 Int32 Real32 Real32 Real32 Int32	deg deg

**Table D2. Continued**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Section 4.1-Data Capture Start Info./Data Capture Start Info.	Data Capture Start Date (yyyymmdd)	1	Int32	
	Data Capture Start Time (hhmmss)	1	Int32	
	Data Capture Start Subtangent Latitude (0.0 ± 90.0)	1	Real32	deg
	Data Capture Start Subtangent Longitude (0.0 ± 180.0)	1	Real32	deg
	Data Capture Start Subtangent Altitude	1	Real32	km
Section 4.2-Data Capture End Info./Data Capture End Info.	Data Capture End Date (yyyymmdd)	1	Int32	
	Data Capture End Time (hhmmss)	1	Int32	
	Data Capture End Subtangent Latitude (0.0 ± 90.0)	1	Real32	deg
	Data Capture End Subtangent Longitude (0.0 ± 180.0)	1	Real32	deg
	Data Capture End Subtangent Altitude	1	Real32	km
Section 4.3-Ground Track Data Over This Event/Ground Track Data Over This Event	Date (yyyymmdd)	11	Int32	
	Time (hhmmss)	11	Int32	
	Subtangent Latitude (0.0 ± 90.0)	11	Real32	deg
	Subtangent Longitude (0.0 ± 180.0)	11	Real32	deg
	Ray Path Direction @ Subtangent Point	11	Real32	deg
Section 5.0-Tropopause Data/Tropopause Data	Tropopause Temperature	1	Real32	K
	Tropopause Altitude	1	Real32	km
	Data Source Indicator	1	Int32	
Section 5.1-Meteorological Data/Meteorological Data	Meteorological Pressure	18	Real32	hPa
	Meteorological Temperature	18	Real32	K
	Meteorological Temperature Uncertainty	18	Real32	K
	Meteorological Altitude	18	Real32	km
Section 6.0-Altitude-based array data/Altitude-based data	Geometric Altitude	200	Real32	km
	Altitude Registration QA Flags	200	Int32	
	Geopotential Altitude	200	Real32	km

**Table D2. Concluded**

Vgroup/Vdata	Field Name	Num. Value	Data Type	Units
Section 6.1-Temperature/pressure profiles/Temperature/pressure profiles	Current Temperature	200	Real32	K
	Current Temperature Uncertainty	200	Real32	K
	Current Pressure	200	Real32	hPa
	Current Pressure Uncertainty	200	Real32	hPa
	Pressure/Temp. Array Source	200	Int32	
Section 6.2-Ozone profiles/Ozone profiles	Ozone Concentration	200	Real32	cm <sup>-3</sup>
	Ozone Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Ozone QA bit flags	200	Int32	
Section 6.3-Nitrogen Dioxide profiles/Nitrogen Dioxide profiles	Nitrogen Dioxide Concentration	200	Real32	cm <sup>-3</sup>
	Nitrogen Dioxide Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Nitrogen Dioxide QA bit flags	200	Int32	
Section 6.4-Nitrogen Trioxide profiles/Nitrogen Trioxide profiles	Nitrogen Trioxide Concentration	200	Real32	cm <sup>-3</sup>
	Nitrogen Trioxide Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	Nitrogen Trioxide QA bit flags	200	Int32	
Section 6.5-OCIO profiles/OCIO profiles	OCIO Concentration	200	Real32	cm <sup>-3</sup>
	OCIO Concentration Uncertainty	200	Real32	cm <sup>-3</sup>
	OCIO QA bit flags	200	Int32	

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## Appendix E

# SAGE III Level 2 Cloud Products

## Table E1. Binary File Format Sheet SAGE III Level 2 Cloud Product

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
001	001	1	I4	0	3	Event Identification Tag (orbit-event code composite number)	<b>Record Header</b>	
002	002	1	I4	4	7	Year-Day Tag (yyyyddd)		
003	003	1	R4	8	11	Instrument Elapsed Time in Orbit (dddd.frac)		
004	004	1	I4	12	15	“Data Fill/Invalid” Value of this Record (Integer Field)		
005	005	1	R4	16	19	“Data Fill/Invalid” Value of this Record (Floating Point Field)		
006	006	1	I4	20	23	Mission Identification (1 = Meteor-3M)		
007	007	1	R4	24	27	Version: Definitive Orbit Processing	<b>Version Tracking</b>	
008	008	1	R4	28	31	Version: Level 0 Processing		
009	009	1	R4	32	35	Version: Director Processing		
0010	0010	1	R4	36	39	Version: Solar Processing		
0011	0011	1	R4	40	43	Version: Spectroscopy		
0012	0012	1	R4	44	47	Version: GRAM 95		
0013	0013	1	R4	48	51	Version: Meteorological		
0014	0014	1	R4	52	55	Version: Cloud Processing		
0015	0015	1	R4	56	59	Altitude-Based Grid Spacing	<b>Record Description</b>	<b>0.5</b>
0016	0016	1	I4	60	63	Number of Altitude-Based Array Values		
0017	0017	1	I4	64	67	Number of Ground Track Values		
0018	0018	1	I4	68	71	Spacecraft-Referenced Event Type (1 = sunrise; 2 = sunset)	<b>Event Type</b>	
0019	0019	1	I4	72	75	Earth-Referenced Event Type (1 = sunrise; 2 = sunset)		
0020	0020	1	R4	76	79	Event Beta Angle (0.0 ± 61.0)		deg
0021	0021	1	I4	80	83	Data Capture Start Date (yyyymmdd)	<b>Data Capture Start Information</b>	
0022	0022	1	I4	84	87	Data Capture Start Time (hhmmss)		
0023	0023	1	R4	88	91	Subtangent Latitude (0.0 ± 90.0)		deg
0024	0024	1	R4	92	95	Subtangent Longitude (0.0 ± 180.0)		deg
0025	0025	1	R4	96	99	Subtangent Altitude		km
0026	0026	1	I4	100	103	Data Capture End Date (yyyymmdd)	<b>Data Capture End Information</b>	
0027	0027	1	I4	104	107	Data Capture End Time (hhmmss)		
0028	0028	1	R4	108	111	Subtangent Latitude (0.0 ± 90.0)		deg

## Table E1. Concluded

Field Num. Start	Field Num. End	Num. Values	F90 Type	Start Byte	End Byte	Description	Eng. Units	Note
0029	0029	1	R4	112	115	Subtangent Longitude ( $0.0 \pm 180.0$ )		
0030	0030	1	R4	116	119	Subtangent Altitude		
0031	0034	4	I4	120	135	Date (yyyymmdd)		
0035	0038	4	I4	136	151	Time (hhmmss)		
0039	0042	4	R4	152	167	Subtangent Latitude ( $0.0 \pm 90.0$ )		
0043	0046	4	R4	168	183	Subtangent Longitude ( $0.0 \pm 180.0$ )		
0047	0050	4	R4	184	199	Ray Path Direction at Subtangent Point (0.0 to 359.9999...)		
0051	0110	60	I4	200	439	Cloud Presence Information (0, 1, 2, 3 or 4)		
0111	0170	60	I4	440	679	Cloud Presence Uncertainty Information (0, 1, 2, 3 or 4) & Uncertainty		
0171	0230	60	I4	680	919	Cloud Areas Entered (0, 1, 2, 3, or 4)		
0231	0231	1	080	920	999	Comment Field (80 Characters)	km	0.5 60 4
<p>This format sheet represents one cloud data record of the Binary Cloud Product File. All records in the file contain the same format except Record 1 (File Header Record)</p> <p>Record 1 is 1000 bytes in length and has one 4-byte integer as the first and only field (bytes 0-3). The field contains the number of records of cloud data that follow in the cloud file.</p>								

**Table E2. HDF File Format Sheet  
SAGE III Level 2 Cloud Product**

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Record #n Section 1.0-File Header/Section 1.0-File Header	Event Identification Tag (orbit-event code composite number) Year-Day Tag (yyyyddd) Instrument ETOS (dddd.frac) Integer Data Fill/Invalid Real Data Fill/Invalid Mission Id (1 = Meteor-3M)	1 1 1 1 1 1	Int32 Int32 Real32 Int32 Real32 Int32	
Record #n Section 2.0-Product Identification/Product Identification	Definitive Orbit Version # Level 0 Version # Database Version # GRAM 95 Version # Meteorological Version # Director Processing Version # Solar Processing Version # Cloud Processing Version #	1 1 1 1 1 1 1 1	Real32 Real32 Real32 Real32 Real32 Real32 Real32 Real32	
Record #n Section 3.0-File Description/File Description	Altitude-based Grid Spacing Number of altitude-based array values Number of Ground Track values	1 1 1	Int32 Real32 Real32	km
Record #n Section 4.0-Event Identification/Event Identification	Spacecraft-referenced Event Type Earth-referenced Event Type Event Beta Angle	1 1 1	Int32 Int32 Real32	deg
Record #n Section 4.1-Data Capture Start Info./Data Capture Start Info.	Data Capture Start Date (yyyymmdd) Data Capture Start Time (hhmmss) Data Capture Start Subtangent Latitude ( $0.0 \pm 90.0$ ) Data Capture Start Subtangent Longitude ( $0.0 \pm 180.0$ ) Data Capture Start Subtangent Altitude	1 1 1 1 1	Int32 Int32 Real32 Real32 Real32	deg deg km

## Table E2. Concluded

<b>Vgroup/Vdata</b>	<b>Field Name</b>	<b>Num. Value</b>	<b>Data Type</b>	<b>Units</b>
Record #n Section 4.2-Data Capture End Info./Data Capture End Info.	Data Capture End Date (yyyymmdd) Data Capture End Time (hhmmss) Data Capture End Subtangent. Latitude (0.0 ± 90.0) Data Capture End Subtangent Longitude (0.0 ± 180.0) Data Capture End Subtangent Altitude	1 1 1 1 1	Int32 Int32 Real32 Real32 Real32	deg deg deg km
Record #n Section 4.3-Ground Track Data Over This Event/Ground Track Data Over This Event	Date (yyyymmdd) Time (hhmmss) Subtangent Latitude (0.0 ± 90.0) Subtangent Longitude (0.0 ± 180.0) Ray Path Direction @ Subtangent Point	4 4 4 4 4	Int32 Int32 Real32 Real32 Real32	deg deg deg
Record #n Section 5.0-Cloud Presence and Uncertainty Data/Cloud Data	Cloud Presence Information Cloud Presence Info Uncertainty Cloud Areas Entered	60 60 60	Int32 Int32 Int32	
Record #n Section 5b-Cloud Comments/Cloud Comments	Cloud Comments	1	Char80	
<b>This format sheet represents one cloud data event of the HDF Cloud Product File. All events in the file contain the same information.</b>				